DOCUMENT RESUME

ED 073 303 VT 019 087

TITLE	A Cost-Effectiveness Analysis of the Vocational Education Program in Puerto Rico.
INSTITUTION	Peat, Marwick, Mitchell and Co., New York, N.Y.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C.; Puerto Rico State Dept. of Education, Hato Rey. Area for Vocational and Technical Education.
PUB DATE	71
NOTE	151p.
EDRS PRICE	MF-$0.65 HC-$6.58
DESCRIPTORS	*Cost Effectiveness; *Educational Programs; Post Secondary Education; *Program Budgeting; Program Costs; Program Evaluation; Program Planning; *Unit Costs; *Vocational Education; Vocational Schools; Vocational Training Centers
IDENTIFIERS	*Puerto Rico

ABSTRACT

To assist decision makers in appropriating funds wisely for vocational school programs, this study was undertaken to: (1) conduct a cost effectiveness analysis of vocational programs administered by the Department of Education, (2) determine variations in unit costs of programs and curricula, (3) identify factors contributing to variations in unit costs, and (4) array programs from the highest rated utility function to the lowest. Some of the major conclusions reached from the cost-analysis technique were: (1) There are considerable cost variations among the districts, (2) Cost variation depends heavily on the number of graduates by districts as well as on the number of courses offered under a program or occupation, (4) Scientific-technical courses increase the absolute cost of a program as opposed to nontechnical courses, and (5) Costs are affected by the level of courses offered. In regard to the cost-benefit analysis, it was concluded that: (1) technical courses generally bring about a higher level of learnings than do nontechnical courses, and (2) benefits are seriously affected by the number of graduates joining the labor force and finding employment on a full and/or part-time basis. (Author/SN)

FILMED FROM BEST AVAILABLE COPY

ED 073303

A COST-EFFECTIVENESS ANALYSIS OF THE VOCATIONAL EDUCATION PROGRAM IN PUERTO RICO

PUERTO RICO DEPARTMENT OF EDUCATION
AREA OF VOCATIONAL AND TECHNICAL EDUCATION

1971

VT013087

ED 073303

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

A COST-EFFECTIVENESS ANALYSIS OF THE VOCATIONAL EDUCATION PROGRAM IN PUERTO RICO

PUERTO RICO DEPARTMENT OF EDUCATION
AREA OF VOCATIONAL AND TECHNICAL EDUCATION

1971

PMM&Co. Peat, Marwick, Mitchell & Co.

The research reported herein was performed pursuant to a grant under the Vocational Education Amendments of 1968. Contractors undertaking such projects under Government Sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions do not, therefore, necessarily represent official Office of Education position or policy.

PREFATORY NOTE

The purposes of this study are: (1) to conduct and document a cost-effectiveness analysis of the vocational-technical education programs administered by the Department of Education; (2) to determine, to the extent possible, variations in unit costs of the vocational-technical education programs and curricula; (3) to identify factors contributing to variations in unit costs; and (4) to array programs from the highest rated utility function to the lowest.

The study also includes an analysis of the conceptual and methodological aspects of cost effectiveness and discusses the sources of data for measuring costs and benefits by programs, occupations, schools, and districts. A set of general recommendations is included at the end of Chapter I.

In the preparation of this study, data made available from the Departments of Education and Labor were used and a computer program, which is described in the study, was utilized to tabulate the data into a meaningful format.

Peat, Marwick, Mitchell & Co. would like to express deep appreciation for the guidance and support it has received from Dra. María Socorro Lacot, Assistant Secretary for the Area of Vocational-Technical Education of the Puerto Rico Department of Education. Conceived by Dra. Lacot, this study is a pioneering one in Puerto Rico and is expected to have a broad impact on a number of government programs.

Peat, Marwick, Mitchell & Co. also wishes to thank Mr. Rafael Ortiz, Mrs. Ana Reyes de Martínez, and Mr. Iván Vega of the Area of Vocational-Technical Education. Without their enthusiastic cooperation

this study would not have been possible. Thanks are likewise extended to officials of the Machine Processing Center of the Department of Education.

To the Commonwealth Vocational Education Board, Peat, Marwick, Mitchell & Co. wishes to express appreciation for the financing of the study.

A COST-EFFECTIVENESS ANALYSIS OF THE VOCATIONAL EDUCATION PROGRAM IN PUERTO RICO

Puerto Rico Department of Education
Area of Vocational and Technical Education

Table of Contents

	Page
INTRODUCTION, SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS	1
Introduction	1
Purpose of the Study	2
Concept and Methodology	3
Utilization of this Report	6
Conclusions	8
Vocational Education and Government Revenues	8
Private and Social Benefits by Programs	8
Cost of Vocational Education by Program	9
Benefit:Cost Ratio by Programs	9
Benefit:Cost Ratios of Selected Occupations	9
Ratio of Benefit to Cost by Selected Districts	10
Ratio of Benefit to Cost of Selected Schools	10
Benefit:Cost Ratio of Dropouts	12
Nonmonetary Benefits	12
Vocational Education and Employment	13
Recommendations	13
GENERAL BACKGROUND	15
Broad Benefits of Education	15
Function of a Vocational Program	15
The Function of a Cost-Effectiveness Approach	17
Achieving Specific Demand Goals	19
System for Decision-making	19
System for Resolving Problems and Bottlenecks	20
CONCEPT OF COST-EFFECTIVENESS ANALYSIS	22
METHODOLOGICAL ASPECTS OF BENEFIT AND COST DATA	25
Methodological Aspects of Benefits Data	25
Benefits to the Industry	31
Benefits to Government from Vocational Training	32
Vocational School Program and Gross Product	35
Determination of Costs	36
Depreciation	40

Table of Contents, Continued

	Page
COST AND BENEFITS OF VOCATIONAL EDUCATION BY PROGRAMS	41
System of Vocational Education in Puerto Rico	42
Cost of Vocational Education	45
Benefits	48
Unit Benefits and Costs	54
Multiplier Effects of Benefits from Vocational Education	57
Total Social Benefits and Unit Cost Ratio	59
Value of Discounted Future Benefits	59
Government Revenues and Vocational Education	64
Individual Benefits and Tax Revenues	68
Benefits Attributable to Vocational Education and Government Revenues	68
Other Benefits from Vocational Education Programs	70
Limitations of Cost Benefit Analysis	72
COST BENEFIT ANALYSIS OF SELECTED OCCUPATIONS	74
Brief Analysis of Selected Occupations	82
Draftsman	82
Medical Assistant	83
Electronic Technician	84
Floral Designer	85
Engineering and Scientific Programmer	86
Secretary	87
Stenographer	88
Clerk Typist	88
Bookkeeper II	89
Baker	89
Cosmetologist	90
Farmer General	92
Auto Mechanic	93
Cabinet Maker	94
Radio and T.V. Service Repairman	95
Dressmaker	96
Electrician	97
Carpenter	97
Plumber	98
BENEFITS AND COSTS OF VOCATIONAL EDUCATION BY SELECTED DISTRICTS	104
Ratio of Benefit to Cost	106
Benefits by Districts	106
Cost by Districts	109

Table of Contents, Continued

	Page
COST AND BENEFIT ANALYSIS BY VOCATIONAL SCHOOLS	111
BENEFIT-COST ANALYSIS OF DROPOUTS	114
Dropouts by Districts	118
Dropouts by Program	119
Technical	122
Home Economics	123
Human Resources	123
Dropouts by Type of School	124

APPENDIX

Computer Processing of Data of Vocational Education	1
Overall Design	2
Input	2
Data Conversion and Validation	3
Processing	3
Bibliography	

I - INTRODUCTION, SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

INTRODUCTION

The goal of vocational-technical education is to produce a body of skilled workers and technologists for employment; the goal of general education is to produce more mature and psychologically well developed individuals (i.e., better citizens). It is difficult to apply a cost-benefit analysis to such a complex goal as that of general education. Cost-benefit analysis is more applicable for an economic assessment of vocational-technical education than it is to general education.

James Bryant Conant[1/] thinks that youngsters who are about to enter the labor market need salable skills, and that their educational experiences should fit their subsequent employment experiences. Vocational education tends to give the student an opportunity to learn salable skills, create feelings of usefulness and self-respect, develop initiative and dependability and increase interest in school. Vocational education attempts to realize these formidable characteristics in the framework of values cherished by young people.

As with many public social programs, vocational education is being subjected to rigorous economic analysis which requires that costs and benefits, both monetary and nonmonetary, be quantified. Analyses are being used to see that vocational-technical education meets the tests of economic efficiency, that program alternatives can be identified for achieving the objectives of vocational education and that costs and benefits of the alternatives can be compared. The concern of the decision makers is that existing

1/ See David C. Gumpper, Social and Psychological Aspects of School Withdrawal: A Review of the Literature, The Pennsylvania State University, p. 10.

resources allocated to vocational education are efficiently used and that new and additional resources committed to vocational education are efficiently used for accomplishing the objectives.

Since vocational education is directed at specific types of jobs and levels of earnings, it is imperative that costs of vocational programs be justified on the basis of outcome. Indirect measures of the economic efficiency of vocational education program such as number of graduates, percentage of graduates employed, and percentage of graduates working in occupations for which they were prepared, are inadequate assessments of the economic benefits of this type of education. For the purposes of making decisions pertaining to resource allocation for vocational education, there is need for more analytical information.

PURPOSE OF THE STUDY

A major purpose of this study is to assist the decision makers in the allocation of funds for vocational school programs. The relevance of such a study stems from increased pressures on the agencies of the Government of Puerto Rico to justify their programs by the use of benefit-cost analysis.

PMM&Co. was asked to (1) "conduct and document a cost-effectiveness analysis of the vocational-technical education programs administered by the Department of Education," (2) "determine, to the extent possible, variations in unit costs of the vocational and technical education programs and curricula being offered by the Department," (3) "prepare and analysis of each factor that contributes to variations in unit costs," and (4) "array all programs from the highest rated utility function to the lowest."

CONCEPT AND METHODOLOGY

Our efforts in this study have been concentrated on cost-effectiveness analysis. This type of analysis provides a framework for making numerical estimates of the vocational training activities on selected outputs available and for estimating the costs of obtaining these effects.

While concentrating on cost-effectiveness analysis, this study has also made sufficient use of the cost-benefit analysis technique. This technique helps to relate total value of benefits of a program to the total costs of the program. However, the technique, when applied to vocational-technical programs, has certain limitations, i.e., (1) a number of benefits cannot be measured in monetary terms, (2) the utility derived from the same benefit differs among different individuals, and (3) it is difficult to measure benefits which might be accruing outside a particular community.

In cost-effectiveness analysis outputs or effects need not be economic in nature and do not necessarily have to be expressed in monetary terms. The most important variables in cost-effectiveness analysis relate to the vocational graduates' performance in the labor market. Such variables are: employability of the graduate, annual earnings (hourly earnings and annual hours worked), labor force participation, etc. Other output variables are the vocational trainees' knowledge, skills and motivations. An obvious advantage of cost-effectiveness analysis as a technique for evaluating vocational-technical education is that is avoids the restriction which requires that all benefits be quantified in monetary terms.

If data are responsive to output-oriented analysis, the costs are not difficult to establish. However, present accounting of the Department of Education, following the norms established by the Department of the Treasury, is responsive to expenditures by objects. Thus, any analysis

oriented toward output must get to the raw data to identify costs by courses, objects, schools, districts, occupations, and programs. The cost data was classified by direct expenditures and indirect expenditures.

To measure benefits, the starting point was the data on enrollment, dropouts and graduates of the vocational-technical program. The graduates then were identified by their status of employment - whether full-time employed, part-time employed, unemployed, or continuing studies. The employment data in conjunction with hourly earnings by occupation was used to establish direct benefits. With the help of the multiplier effect, total social benefits were established. Net benefits of vocational education were established by deducting from total earnings the earnings attributable to nonvocational education. Since benefits accrue over a period of years while costs are incurred in the present, future benefits must be discounted to make them comparable to present costs. This was done with the help of an index based on growth of earnings and the discount rate. Since monetary benefits to individuals and society are subject to various taxes, the Government revenues were estimated with the help of effective rates established by an unpublished study conducted by the Commonwealth Department of the Treasury. Nonmonetary benefits have also been spelled out in this study.

This study, concomitant with the objective, assumes that economic improvement is a primary objective of vocational-technical education. Therefore, vocational courses and programs are considered to have effects leading directly or indirectly to advances in the standard of living. These advances are measured in terms of the net economic gains they produce, both immediately and over the years of a person's working life. This assumption implies that changing the number of enrollees and graduates (outputs) are intermediate objectives, whose value in the free enterprise society depends

on the degree to which they lead to subsequent economic improvements of individuals, society, industry, and government. This assumption also implies that improvements in knowledge, skills, motivations and discipline are immediate objectives, which are eventually reflected in economic improvements and reductions in antisocial behavior as measured by type two crimes, that is, minor crimes.

In order to isolate the net effects of the vocational-technical education, we have estimated, with the help of the Department of Labor, the hourly wage for individuals similar to the trainees who have not had vocational training. The net vocational-technical training effect is the difference between the change in earnings from before training and after training. It must be noted that the validity of the net effect depends on the degree of match achieved between the trainees' earnings and nontrainees' earnings.

Both total social benefits and net benefits from vocational-technical education were projected into the future for six years to obtain a stream of benefits. The empirical basis for making the projection, that is, measuring the discounted benefits, is explained in the study.

It is assumed that future improvements in the employment data, wage rates and hours worked per year, of the vocational graduate, would not change the absolute total difference credited to his vocational training. Although the number of vocational school graduates working would change due to attrition by death, disability, sickness, etc., the study assumes no such changes.

The study computes the unit cost of vocational education on the basis of number of graduates and total expenditures in 1969-70. It is believed that an input of a certain amount of expenditures produces an output

of a certain number of graduates, plus a number of dropouts. Thus, the training cost of nongraduating students is transferred to graduates. The "graduates" constitute for the analysis of the study a measurement of "final output."

In the processing of the data on costs and benefits for this study, we used the computer facilities of the Department of Education. The data processing system developed for this study is expected to serve as a tool for future analyses of this nature. The system and computer programs have been made available to the Department of Education.

UTILIZATION OF THIS REPORT

This report may be utilized for several purposes, both internally within the Department of Education and externally by other agencies within the Commonwealth Government.

Department of Education

1. This report may serve as the basis for justification of planned expenditures within the vocational educational program during the preparation of the annual budget. Each dollar spent on a specific vocational program may be shown to yield specific dollar benefits to the Puerto Rican community.

2. This report may serve as a means for allocating vocational funds among alternative courses, geographic regions, and individual schools. Ideally, with an unlimited source of funds, additional funds could be expended in each program and geographical region until the cost to benefit ratios were all equal to unity. However, this is not the case since we have limited funds which must be allocated among various alternatives in the most effective possible manner. The benefit to cost ratios developed in this study may be combined in a linear or nonlinear programming model with given constraints upon the vocational system in order to optimize the allocation of available funds among the available alternatives. Our benefit to cost ratios may also serve as a quick rule of thumb to aid the Department in deciding between two or more alternatives--funds should be expended on the alternative with the highest benefit to cost ratio.

3. This report may be utilized to begin an internal cost reduction system for the vocational educational program. Those vocational programs with above average unit costs (i.e., cost per graduate) should be examined carefully to determine whether the cost could be reduced by consolidating the number of course offerings, reducing the number of schools offering the same program within the same geographic region at the same time, or a

combination of both. The Department of Education may also expand upon the report by collecting and identifying cost information for each of its schools offering vocational programs. The methodology and computer programs developed by PMM&Co. for this study will facilitate their collection and analysis of additional data. Costs could be compared by program, school, and by school within a given district. The difference among the unit costs per school would serve as an effective tool for determining relative efficiency within the system as well as serving as a basis for determining potential areas of reduction--either in the number of course offerings at a given school or in the consolidation of courses offered on a regional basis. In addition, the Department of Education would be able to compare its unit cost per program to figures for similar programs in other states. Although the derivation of the unit cost figures may differ, along with the quality of instruction, the comparison may nonetheless prove valuable.

Other Governmental Agencies

1. Budget Bureau - Governor's Office:

This report may serve as an example of cost-benefit analysis being used within certain segments of the government to provide a rationale for expenditures on projects based upon their expected return to the Puerto Rico community. In addition, this type of analysis may be utilized to allocate available government funds among competing alternatives based upon their cost-benefit ratios.

2. Legislature

The Legislature may use this report as a basis for deciding on appropriations for vocational education programs and expenditures in other areas. At the very least, the Legislature would be able to determine the return for additional expenditures on vocational projects.

3. All agencies:

All other governmental agencies may examine this type of analysis for their own internal use in control and budgeting. When cost-benefit analysis is applied successfully to one agency's problems, it may then be utilized by other agencies.

CONCLUSIONS

Vocational Education and Government Revenues

1. One of the major conclusions emerging from the study is that if the opportunity cost of the vocational-technical trainees is considered to be zero, the return to the Government in the form of tax and nontax revenues is 69.7 per cent of the total expenditures incurred on the job-oriented vocational programs of the Department of Education. The Government of Puerto Rico incurred $23.5 million of expenditures in connection with vocational-technical education programs in 1969-70. The program produced 26,500 graduates, who within one year of work created private benefits of $58.4 million and social benefits of $116.9 million. These social benefits brought back to the Government of Puerto Rico $16.4 million. This means that the social benefits derived over a period of about 17 months reimbursed the Government of Puerto Rico for the total expenditures incurred by job-oriented vocational-technical education for the preceding 12 months.

2. From the revenue standpoint the most lucrative vocational programs were Distribution, Human Resources, Industrial Arts, Trade and Industry, and Office Occupations. The return to the Government from the programs of Agriculture, Health, Technical and Cooperative Industry Occupations was low due mainly to the fact that the social benefits generated by these programs were low.

Private and Social Benefits by Programs

3. Total private benefits to graduates amounted to $58.4 million within a period of 12 months of their commencing work. With the multiplier effect of 1:1, the total social benefits are estimated to amount $116.9 million, or 3.2 per cent of the 1970 net income of Puerto Rico.

4. Private benefits to graduates, per program, can be arranged from the highest to the lowest as follows: Distribution - $22.4 million, Trade and Industry - $15.3 million, Office Occupations - $6.8 million, Human Resources, Industrial Arts - $5.4 million, Home Economics $3.6 million, Health - $1.9 million, Agriculture $1.1 million, and Cooperative Industry Education - $0.7 million.

5. Unit benefit was the highest in the case of the Technical program, followed by Health, Human Resources, Industrial Arts and Distribution. Unit benefits were low in the cases of Agriculture, Home Economics and Office Occupations.

6. The present value of a stream of social benefits, projected five years into the future, attributed to vocational-technical education, was high in the case of the technical program at $11,363, Health $9,493, Distribution $9,348, Human Resources, Industrial Arts $8,785. On the other hand, such benefits from Home Economics, Agriculture, and Trade and Industry were low.

Cost of Vocational Education by Programs

7. Total cost of job-oriented vocational-technical education amounted to $23.5 million, of which 26.1 per cent was spent on Trade and Industry, 13.5 per cent on Home Economics, 12.5 per cent on Office Occupations, 10.9 per cent on Health, 8.8 per cent on Agriculture, 8.4 per cent on Technical, 7.2 per cent on Cooperative Industry Education, 6.4 per cent on Distribution, and 6.0 per cent on Human Resources and Industrial Arts.

8. The largest percentage of total expenditures was incurred by salaries, with a total of 48.8 per cent, followed by Administrative expenditures at 14.8 per cent, building and improvement 5.7 per cent, books and materials 4.1 per cent, maintenance 3.7 per cent, equipment and furniture 7.6 per cent, overhead 10.5 per cent, and miscellaneous expenditures 4.8 per cent. The individual programs, however, had significant variations in the mix of expenditures. For example, the Trade and Industry program absorbed 63.7 per cent in the form of salaries and wages of the total expenditures on the program, as compared to 28.7 per cent for the Technical program.

9. Unit cost varied markedly from program to program. The Technical program had a unit cost per graduate of $5,298 and the Distribution program had a unit cost of $175. The unit cost of the Agricultural program was high at $4,240 and Office Occupation program was as low as $725.

Benefit:Cost Ratio by Programs

10. There were a number of programs where the benefit:cost ratio exceeded unity. Human Resources and Industrial Arts had a benefit cost ratio of 3.8:1, Trade and Industry 2.5:1, Office Occupations 2.3:1, Home Economics 1.1:1. The highest benefit:cost ratio was for the Distribution program at 14:1. In the case of the Agricultural program, benefit:cost ratio was low at 0.54:1. As a general rule when the benefit:cost ratio exceeds unity, the corresponding activity is economically superior to an alternative activity with a lower-than-unity benefit:cost ratio. If purely economic criteria are to be used in determining vocational expenditures, then the programs chosen should be those having the highest benefit:cost ratios. However, the decision makers may elect to consider additional criteria of a noneconomic nature (such as "keep the kids off the street") in the decision-making process.

10.a. In deriving the preceding conclusion, the study used only one year as the source of benefit to the individual. However, if two years are used, the benefit:cost ratio in almost all the programs will be more than unity. It may be noted that the working life of a vocational graduate is about forty-five years and the benefits will accrue over all those years.

11. When the present value of the 0/ five future-year stream of social benefits per graduate attributed to vocational education is compared with the unit cost, all the programs have benefit:cost ratios above unity. The ratios are in the range from 1.3:1 in the case of the Agricultural program to 53.4:1 in the case of the Distribution program.

Benefit:Cost Ratios of Selected Occupations

12. A nucleus of courses or a combination of courses is required for a trainee to enter a particular trade or occupation. One part of the study

compared specific costs of courses to specific benefits from specific occupations. Since the Department of Education gives hundreds of courses to prepared trainees for hundreds of occupations, the study selected only 19 occupations for detailed analysis. Benefit:cost ratios for the selected occupations are arrayed from the highest to the lowest as shown in the attached table. It may be noted that each one of the 19 occupations is discussed in Section VI of this study.

13. Variations in benefit:cost ratios depended very heavily on variations in costs, and to some extent on unit benefits. Unit benefits depended on hourly wage rates and on the ratios of full-time and part-time employed graduates to unemployed graduates. The unit cost were above average for the occupations of auto-mechanic, farmer general, electronic technician, carpenter, cosmetologist, baker and medical assistant. The costs were higher due to: (1) small number of graduates (e.g., electronic technician, floral designer, engineering and scientific programmer and T. V. service repairman); (2) too many schools offering the same course with a small number of graduates per school (e.g., medical assistant, cosmetologist, farmer general, auto-mechanic, cabinet maker, T.V. service repairman); (3) high original investment (e.g., medical assistant, electronic technician, floral designer, engineering and scientific programmer, cabinet maker, T.V. service repairman), and (4) high administrative costs (e.g., electronic technician, engineering and scientific programmer, baker, dressmaker, etc.).

Ratio of Benefit to Cost by Selected Districts

14. Among the eight selected districts, the ratio of benefit:cost averaged 3.33:1, with ratios of 4.75:1 in Mayaguez and 1.56:1 in Cayey. The ratio of benefit:cost was low in the districts of Fajardo (2.08:1) and Quebradillas (1.85:1). In addition, the districts of Camuy, Ponce, San Juan and Humacao were analyzed.

15. Major conclusions emerging from the cost side of the analysis are: (a) that there are considerable cost variations among the districts; (b) that cost variations depend heavily on the number of graduates by districts; (c) that cost variations also depend on the number of courses offered under a program or occupation; (d) that scientific-technical courses increase the absolute cost of a program, as compared with nontechnical type of courses; and (e) that costs are affected by the level of courses offered - whether at the senior high school level or at the junior high school level.

16. On the benefit side of the analysis, major conclusions emerging are: (a) that technical courses generally bring about a higher level of earnings as compared with nontechnical courses, and (b) that benefits are seriously affected by the number of graduates joining the labor force, and finding full-time or part-time jobs.

Ratio of Benefit to Cost of Selected Schools

17. Among the eight vocational school districts discussed, the following five schools were selected for cost-benefit analysis. Their benefit:cost ratios are given on the next page.

TABLE I-1

BENEFIT TO COST RATIO BY SELECTED OCCUPATIONS

(From Highest to Lowest)

Occupation	Benefit to Cost Ratio
Electrician	4.3-1
Clerk typist	3.3-1
Secretary	3.2-1
Bookkeeper II	2.8-1
Stenographer	2.8-1
Engineering and Scientific Programmer	2.3-1
Draftsman	1.8-1
Dressmaker	1.2-1
Cabinet Maker	1.2-1
Plumber	1.1-1
Midical Assistant	1.1-1
T.V. Service Repairman	.76-1
Carpenter	.69-1
Electronic Technician	.6-1
Cosmetologist	.5-1
Baker	.5-1
Auto Mechanic	.28-1
Farmer General	.09-1
Floral Designer	.04-1

School and Location	Benefit:Cost Ratio
- A. Lucchetti - Arecibo	4.6:1
- República de Costa Rica - Caguas	2.3:1
- Dr. Pedro Perea Fajardo - Mayaguez	5.4:1
- Miguel Such - Río Piedras	8.8:1
- Superior Vocational - Ponce	4.0:1

18. These five schools had 14 per cent of total enrollment of all vocational education programs in 1969-70. Total cost for these five schools is estimated at $1,542,000 and total individual benefits are estimated at $8.5 million. The unit cost reveals that the larger the number of enrollment and graduates, the lower the cost of training of every student.

Benefit:Cost Ratio of Dropouts

19. The benefit:cost ratio of dropouts is lower than that of the graduates. Generally, it is believed that vocational students may be dropping out in response to the availability of job opportunities rather than because of any fundamental inability to complete the course successfully. Analyses indicates that varying dropout rates may be due to economic pressures of the job market in a particular occupation or area. Major conclusions of the section on dropouts are that: (a) the dropout rate is higher in big cities, where dynamic economic growth is underway, than in small towns; (b) programs with growing occupational needs have a higher dropout rate; (c) schools located in major metropolitan areas with concentration on high demand occupational courses have high rates of dropouts; (d) that programs with attached economic incentives (e.g., remuneration while studying) have lower dropout rates; (e) that more demanding courses (including science, mathematics, etc.) produce higher rates of dropouts; and (f) that a student from a disadvantaged background is more likely to drop out to accept job opportunity than is a student from a middle class home.

20. Since generally the vocational students become dropouts in response to job opportunities, the dropouts like graduates, also create private income and social benefits. It is estimated that the private benefits of 2,805 dropouts amounted to $4.8 million and the social benefits to $9.6 million. These benefits are in addition to the benefits brought in from graduates of vocational-technical education.

Nonmonetary Benefits

21. Vocational-technical education increases private and social benefits, industry profits, and Government revenues. In addition, vocational education keeps the young people from idling in the streets, thus lowering the crime rate and reducing Government expenditures for law enforcement. Vocational education reduces the dependency of families on Government services such as health, housing and welfare. Vocational education helps improve family stability, physical health, nutrition, and reduces sickness, hospitalization and absences from jobs. These familial, economic and social improvements should favorably influence mental attitude, morale and aspirations, and perhaps greater neighborliness. Advantages of these social developments to the children of vocational school graduates should be significant, indeed.

Vocational Education and Employment

22. The 1970 follow-up survey conducted by the Department of Education reveals that about 16 per cent of the vocational graduates were unemployed in January 1970. A survey conducted at the same time by the Puerto Rico Planning Board shows that 30.9 per cent of 110,000 young people in the age group of 16-21 were unemployed. This 30.9 percentage covers both vocational graduates and nonvocational youth. It is estimated that nonvocational youth had an unemployment rate of 36 per cent as compared to the rate of 16 per cent for the vocational graduates.

23. Since the rate of unemployment among nonvocational youth was very high, earnings foregone by vocational enrollees did not represent a net social cost. Absence of vocational enrollees from the labor market did not leave vacant the jobs they would have filled. Thus, earnings foregone or opportunity cost for enrollees' time was small.

RECOMMENDATIONS

1. From the analysis conducted by this study, it is clear that vocational-technical education is an economically and socially worthwhile investment for the Government of Puerto Rico, for the society as a whole, and for individual trainees. The findings of this study become more meaningful and relevant when we look at the requirements of the labor market. In the modernizing and industrializing of Puerto Rico, the technology likely to be used no longer requires a high proportion of unskilled and untrained workers. When benefits to the society, government, and individuals are higher than the costs incurred and there is a substantial need for skilled workers, the inevitable conclusion is that additional public funds should be spent on the vocational-technical programs of the Department of Education.

2. This study provides an instrument in the area of optimum allocation of public resources in vocational-technical education. This study measures both costs and benefits. As shown in the various sections of the study, costs alone cannot be taken as an indication of quality or costliness, nor can benefits be evaluated without taking account of the costs. Thus, the study recommends that in the allocation of funds, both costs and benefits, ought to be taken into account in reaching decisions.

3. Statistical analysis of costs as well as benefits show that there is a need for considerable refinement in the area of availability of data. It is recommended that the Department of Education keep adequate and up-to-date cost records. This requires the maintenance of current and historical data in consistent and relevant classifications. Such data should correspond to the school, curriculum and course level. Equally important would be to gather data on long-term benefits through follow-up surveys. We reiterate the recommendations made by a number of studies that the Department of Education should establish a Management Information System at the earliest possible time for the Area of Vocational and Technical Education. The information system which could be establihsed should respond to the decision-making function and responsibilities of the Department of Education.

4. Cost-benefit ratios by programs, occupation, schools, and district provided in this study suggest that further efforts should be made to determine the degree to which various vocational-technical programs are being efficiently operated, independent of the question of optimum allocation of resources between alternative vocational-technical programs. This implies that the Department of Education should undertake an analysis of production and cost functions of vocational-technical programs. It should be possible from such an analysis to arrive at decisions which could lead to elimination of some courses and/or consolidation of curricula.

II - GENERAL BACKGROUND

BROAD BENEFITS OF EDUCATION

The effects of education on society take various forms which have been described as investment, consumption, waste, or drag.

When one considers how improved intellectual skills (e.g., improved reading abilities) might contribute to an individual's future productivity, it is easy to see that education is an investment by society. That is, if individual productivity improves, the productivity of society as a whole will be improved. Furthermore, with youth constructively occupied, losses in output due to delinquency, unemployment, or underemployment will be reduced; and when students are eager for more knowledge, education will become a consumption good.

At the same time, educational efforts can be wasteful if they provide neither satisfaction to individuals nor increased productivity of goods and services. Finally, education can be a drag on both the society and the individual if it is misdirected in terms of society's needs or of workers' aptitudes.

FUNCTION OF A VOCATIONAL PROGRAM

Vocational education, in particular, is specifically geared to supplying the needs of an expanding industrial - manufacturing sector for the multi-skilled or semi-skilled services generated by a growing economy such as Puerto Rico. Specifically, vocational education produces positive effects on the quality of labor which are of special relevance to an economy in the process of promoting rapid growth:

1. Better working habits, increased labor effort, and greater reliability.

2. Improved skills, better understanding of a job's requirements, and increased efficiency in performing the job.

3. Better health through improved diet and sanitary living conditions.

4. Greater and speedier adaptability to momentary changes, especially in jobs which require work evaluation of new information, and in general, more rapid reactions.

5. Increased chances for promotion to more complex occupations when opportunities arise.

While it is true that all levels of education may contribute to improving the quality of labor, this study focuses on the contributions of vocational education to particular program goals, as well as to the general economic development of Puerto Rico. It is clear, for example, that there is a broad need for many skills in Puerto Rico, with shortages of skilled or semi-skilled manpower in nearly every field. The manufacturing sector, especially, can be severely inhibited in maintaining its dynamic expansion programs if there is a serious lack of skilled personnel to carry them out. Thus, such limitations in personnel can seriously affect productivity levels, in turn raising costs and preventing industry from competing effectively in the highly competitive markets into which many Puerto Rican commodities must move.

A dynamic vocational education program can make a significantly high return contribution to Puerto Rico's growth and welfare by supplying, on a systematic basis, the ongoing and changing skill requirements of the economy.

Secondly, a dynamic vocational training program can, in a limited time span, make a significant contribution in reducting unemployment, particularly among the younger members of the labor force in Puerto Rico.

Thirdly, a rapidly growing economy faces the problem of absorbing those workers who have migrated to the city from the country. If there is to be a minimum of social unrest in the growing urban centers, a steady supply of job opportunities must be provided. By upgrading and broadening the capacities of workers, an effective vocational education program can make a significant and readily apparent contribution toward the urban unemployment problem while satisfying the needs of enterprise and social services.

Fourth, must be added the need to reduce the underutilization of latent talent, which imposes an enormous waste of human resources on Puerto Rico's economy. No modernizing economy can, whatever its size or status, afford such waste of its productive capacity.

Fifth, it is also important in an economy linked so closely to that of the United States to generate the optimum growth of productivity, so that Puerto Rico maintains its competitive position in the complex markets of the United States.

By adding a continuous flow of more skilled individuals to the economy of Puerto Rico, the vocational education programs will not only contribute to more stable growth and social well being, but will also make a special contribution to more stable industrial relations, as laborers recognize the advantages of sharing in the economy's growth process.

Finally, and indicative of the points just elaborated, there is considerable statistical evidence to indicate that vocational-technical student graduates have shown highly favorable earnings and employment duration experience. This indicates that the need for student graduates in the more academic curricula is matched by a strong, and in Puerto Rico possibly by an even stronger need for student graduates of vocational-technical schools or training programs.

THE FUNCTION OF A COST-EFFECTIVENESS APPROACH

An effective cost-benefit analysis requires collection of a wide variety of data inputs. However, it must be said at the outset that the difficulties of data collection present very serious obstacles to implementing a workable cost-effectiveness approach to decision-making. It is vital, however, that the ground work be laid now for the gradual accumulation of the data necessary for evaluating the contributions of vocational education to the growth process of Puerto Rico. Ultimately, costs and benefits may be

identified in terms of the physical inputs and outputs of the programs, in terms of the monetary inputs and gains, or in terms of a combination of the two; and it is to this latter complex combination of measures and utility functions that this study addresses itself.

The costs and benefits from education are often summarized in the following categories:

A. Explicit costs incurred by students or their families (time and money outlays).

B. Implicit costs incurred by students or their families (chiefly time and earnings foregone).

C. Explicit costs incurred by the Government or third parties (physical facilities or money outlays).

D. Implicit costs incurred by the public or third parties (chiefly earnings or tax revenues foregone).

E. Monetary benefits accruing to the educated or to their families (earnings in money or in kind).

F. Nonmonetary benefits accruing to the educated or their families (satisfactions, psychic well being).

G. Monetary benefits accruing to the public or to third parties (money incomes or tax revenues).

H. Nonmonetary benefits accruing to third parties or the public (increased skills in labor force, reduction in the waste of resources caused by unemployment or underemployment, individual satisfactions, psychic incomes).

For the costs side, data can be collected on the nonmonetary inputs and on budgetary outlays by the Government for various requirements of the vocational education program. On the benefits side, data can be collected on the numbers of newly trained employees in various occupations and their level of earnings as a result of their training. Estimates can also be made regarding tax revenue increments resulting from the higher income levels of vocational graduates as compared with the earnings of unskilled labor or even graduating students who have not received vocational training.

A dynamic rather than static vocational program requires the following: (a) a system for gauging probable demand goals in specific skilled categories; (b) an effective system for decision-making, (c) an effective system for resolving immediate, intermediate, and long-term problems and bottlenecks and estimating the long-term needs of Puerto Rican labor and the economy as a whole. Such systems will give the decision maker an orderly and continuous purview of the needs, costs and effectiveness of the vocational education programs.

(a) Achieving Specific Demand Goals

Data should be collected, organized, and analyzed in order to determine the demand for skills in various categories of work. At the same time, the administrative system should be prepared to adjust to changing demands resulting from fairly rapid technological advances. Normally, a system for forecasting both short-term and long-term skill needs in the economy would be necessary. The system would provide a knowledgeable appreciation of new technology, which may permeate certain industrial sectors and which could completely change the demand structure for skill requirements. There must also be an awareness of new forms of investment in the industrial, commercial or services sectors which could lead to requirements for new skills. On the basis of a systematic knowledge of the short, intermediate, and long-term demand for various skill requirements in the economy, the administrative responsibility and function may turn to planning for meeting these demands and implementing a program with appropriate phasing profiles which would satisfy the needs ascertained from the data accumulated and evaluated.

(b) System for Decision-making

Given the knowledge of demand and the targets for fulfilling the demand for skills in the short, intermediate, and long-terms, the

cost-effectiveness procedure should provide a framework for asking the critical administrative questions on:

- How to proceed to fulfill the demand requirements;
- Which categories have highest priority;
- What curriculum is relevant or should the curriculum be changed to meet the new requirements;
- What are the capital outlay requirements for meeting the demands;
- Who should pay for the expansion in specific skill categories and how will these be financed;
- How shall the expansion be administered;
- What means will be devised for recruiting teachers who are the essential inputs for developing the best in new applicants for the program.

The cost-effectiveness program proposed by Peat, Marwick, Mitchell & Co. will provide a system for decision-making on all of these issues. It will also provide a framework for answering the question of how administrative responsibilities could best be delegated - by function or by geographic region.

(c) System for Resolving Problems and Bottlenecks

This system should encompass:

- A thorough knowledge of the orientation of Puerto Rico's development program;
- A clear appreciation of the demand structure for various categories of skills in the short, intermediate, and long-term;
- A method for identifying the priorities of issues awaiting decision-making in accordance with their relative importance and urgency;
- An appreciation of the need for strategy to resolve the hierarchy of problems defined above;
- And a system for projecting future requirements for vocational education programs and their related costs.

The information provided in this study makes a significant beginning toward formalizing the data categories required for assessing the cost-effectiveness of Puerto Rico's vocational education program. By comparing the physical and monetary cost elements of the program with its physical accomplishments and growth factors, the monetary advantages to individuals involved in the training programs, the indirect benefits to Puerto Rico's fiscal needs, and the need for steadily increasing productivity of Puerto Rico's goods and services, decision-makers can thus, have available to them more effective and rational criteria for establishing priorities, developing new programs, and supporting the budgetary requirements of the total vocational education program in Puerto Rico.

III - CONCEPT OF COST-EFFECTIVENESS ANALYSIS

Cost-effectiveness analysis relates the cost of a particular program to how well it has met its objectives and goals. The decision-maker compares possible or alternative programs on the basis of least cost and probable greatest effectiveness, always seeking to minimize dollar costs while maximizing the physical output within budget limitations.

Using cost-effectiveness analysis, comparisons of alternative programs are prepared systematically in qualitative and quantitative terms by using a logical sequence of steps that can be retraced, verified and evaluated by others. The cost-effectiveness analysis concept requires the ranking of various alternatives, or courses of action available, in order of preference; and criterion for ranking preferences is the relationship of cost to the anticipated performance or output of each alternative.

The difference between cost-effectiveness analysis and cost-benefit concepts is that under cost-effectiveness, nonquantitative measurements are permitted, whereas in cost-benefit analysis, only quantitative measures are used.

Vocational education can benefit greatly by the application of cost-benefit analysis, provided the emphasis is placed on effectiveness rather than cost. In vocational education as well as any other type of education, costs can be measured rather accurately whereas the benefits do not easily lend themselves to appropriate types of quantifications. Although educational costs are incurred over a short period, educational benefits are realized over the course of a working life which may last from 40 to 50 years.

There are various types of costs: current costs, capital costs average costs, and marginal costs. The current costs concept generally includes salaries and wages, books and materials, maintenance, administration, etc.

Capital expenditures are investment costs incurred for the purchase of equipment and construction of buildings. Marginal costs refers to those additional costs that are to be incurred if a particular program is to be expanded. The concept of average cost per hour deals with the total universe.

Similarly, benefits, both direct and indirect, are of different types and accrue to different groups in the society. From the vocational education program, benefits accrue to the individual receiving training in the form of increasing earnings. Benefits accruing to the industry and employers who employ such trainees include reduced costs of training for specific jobs. Benefits accrue to society through the multiplier effect of gross product, net income and personal income. Benefits to the Government accrue in the form of reduced expenditures on welfare payments and by increased tax revenues. Since the income of both individuals and industry is subject to a variety of taxes, including personal income tax, corporate income tax, excise tax and property tax. The individual trainee likewise passes on the benefits of his education to his family in very direct ways, for example, by enhanced ability to enjoy a variety of recreational activities.

Measuring and computing educational benefits in cost-benefit analysis can be very difficult. For example, an individual may decidedly improve his character and personality by means of his education; but measuring such improvements in character can be problematic. For this reason, cost-effectiveness analysis, rather than cost-benefit analysis, is more broadly applicable since all of its components are quantifiable.

One of the greatest advantages of cost-effectiveness analysis is that, while cost-benefit analysis may yield a single decisive ratio, cost-effectiveness analysis results in a number of criteria or different definitions of objectives for a program. Secondly, most of the analyses currently

being prepared give too much emphasis to cost: such as cost of educating an elementary student per year, or cost of educating a secondary student per year, or cost of educating a student in auto mechanics per year. Over-emphasis on cost does not permit the determination of the effectiveness of dollar expenditure on different levels of education. For example, if a student is taught for two years at the 11th and 12th grade levels and after education he remains unemployed for a number of years, obviously, the benefits accruing to the society from such an educational expense are not significant. On the other hand, if a student is trained in auto mechanics, for which there is an increasing demand, it is true that a high training cost will be incurred, yet his early employment at high wages should reimburse the society, the individual, the industry and the Government within a reasonably short period of the individual's working life.

In the measurement of costs and benefits, accuracy of data is a very important element. Equally important is the use of appropriate techniques for analysis and computations of benefits and costs. The methodology for the compilation of data and analysis is discussed in the next section.

IV - METHODOLOGICAL ASPECTS OF BENEFIT AND COST DATA

This section of the study discusses the methodology used in determining benefits and costs for the vocational school programs. It should be clear that the methodology used for the study is tailored to ideal conceptual aspects of cost-effectiveness analysis and availability of data.

Generally, it is believed that in conceptual terms benefits are more difficult to measure than costs. For the methodology used in this study, however, the benefit data turned out to be less of a problem than the cost data. Resolving shortcomings in the data, absorbed a major part of our time; nevertheless, despite difficulties, the costs and benefits have been prepared for all the vocational programs, selected occupations, selected educational districts, selected schools, and dropout students.

In the processing of the data for this study, we used the computer facilities of the Department of Education, whose Data Processing Division was extremely helpful. The data processing system developed for this study is ultimately envisioned as a tool to aid in the continuous analysis of costs and benefits. Both the system and the computer programs have been made available to the Department of Education.[1/]

METHODOLOGICAL ASPECTS OF BENEFITS DATA

This section of the report briefly presents the methodology used for measuring social benefits accruing to society and private benefits accruing to an individual from the vocational-technical education program. While some of the benefits are measurable, a number of benefits are not subject to the rigid discipline of economic analysis.

1/ See a note on computer processing in the Appendix of the study.

The science of economics measures only those benefits and costs which generally occur within the market mechanism. If benefits and costs accrue outside the market mechanism they are generally excluded from this type of study, even when they are measurable. The benefits accruing outside the market mechanism obviously will result from external economies or diseconomies. However, stretching the analysis to encompass external economies will not have any logical end, and also, there is a danger of double counting, as different aspects of any action begin to have overlapping effects.

Since earnings and employment are adequate indices of economic efficiency and economic welfare, this study tries to measure benefits with the help of employment, partial employment, and unemployment data. Necessary figures on monetary earnings can be obtained from the employment data since the data includes number of hours employed, earnings per hour, and total earnings.

The employment data is based on follow-up surveys prepared by the Department of Education, which, through its Vocational School Program, conducts follow-up surveys to investigate the employment status of vocational school graduates. This data provides information as to whether a graduate entered the armed forces, continued full-time school, or for any other reason is not in the labor force, his status of employment, and whether he has entered an occupation for which he was trained or a related occupation. Also, the data provides the necessary information on graduates who are employed part-time and on the number of graduates unemployed.

The data presented by the Department of Education in the early part of January, 1970, estimated that during the fiscal year ending June 30, 1969, there were 1,692 graduates who had completed post-secondary vocational

school requirements and were sent questionnaires to determine their employment status. Of the 1,692, the status of 483 was not known, 867 were full-time employees in the occupation for which they were trained or in a related occupation, 81 graduates were employed part-time and 165 were unemployed.

This data also estimated that during the same year, there were 8,366 graduates who had completed secondary vocational school requirements and were sent questionnaires to determine their employment status. Of the 8,366, the status of 2,594 was not known, 113 has entered the armed forces, 1,802 had continued full-time school, and 184 did not join the labor force for other reasons. Of the remainder, 2,052 were full-time employees in the occupations for which they were trained or in a related occupation, 653 graduates were part-time employees and 968 were unemployed. Details of the data by programs for 1970 are given in Table IV-1 and Table IV-2.

These data were used to determine the total universe, the number employed graduates, unemployed, partially employed, etc.

The second variable to be ascertained was earnings of the fully employed graduates and partially employed graduates. We consulted with the Department of Labor for the data on earnings of workers with specific skills which are generally acquired through the vocational school programs of the Department of Education. The hourly earnings then were multiplied by the number of hours which a full-time worker would be working in a full year. For the part-time workers we assumed that they worked one-half the number of hours worked by the full-time employed graduate. Thus, in the determination of data on earnings, the following variables were taken into account: (1) type of employment, (2) percentage of graduates employed full-time or part-time, (3) wage rates per hour, (4) number of hours, (5) increases in income, (6) total benefits, (7) type of employment before vocational school training,

TABLE IV - 1

SECONDARY VOCATIONAL SCHOOL GRADUATES EMPLOYMENT STATUS

Program	Total Number Completed Program Requirements	Number Status Unknown	Number Not Presently Available For Placement 1/	Civilian Labor Force	Full-Time Employed				Part-Time Employed	Unemployed
					Total	Occupation Trained	Related Occupation	Other		
Agriculture	1,018	578	270	170	118	38	18	62	24	28
Distribution	418	34	109	275	232	170	40	22	27	16
Health	176	46	46	84	70	56	9	5	5	9
Home Economics	1,184	335	275	574	273	151	67	55	94	207
Office Occupations	3,236	912	875	1,449	743	374	186	183	238	468
Technical	-	-	-	-	-	-	-	-	-	-
Trades and Industry	2,334	689	524	1,121	616	340	101	175	265	240
Total	8,366	2,594	2,099	3,673	2,052	1,129	421	502	653	968

1/ Includes graduates who entered the armed forces, continued full-time school and those with other reasons for not entering the labor force.

Source - Department of Education: Follow-up of Enrollees in Preparatory Vocational Education Programs (Form OE 4045) Fiscal Year 1969

TABLE IV - 2

POST SECONDARY VOCATIONAL SCHOOL GRADUATES EMPLOYMENT STATUS

Program	Total Number Completed Program Requirements	Number Status Unknown	Number Not Presently Available For Placement 1/	Civilian Labor Force	Full-Time Employed				Part-Time Employed	Unemployed
					Total	Occupation Trained	Related Occupation	Other		
Agriculture	288	112	8	168	105	52	18	35	9	54
Distribution	219	66	14	139	116	69	31	16	7	16
Health	475	73	24	378	329	304	23	2	23	26
Home Economics	-	-	-	-	-	-	-	-	-	-
Office Occupations	370	129	31	210	147	78	43	26	32	31
Technical	151	64	4	83	76	62	8	6	2	5
Trades and Industry	136	27	4	105	71	40	12	19	4	30
Hotel School	53	12	11	30	23	17	4	2	4	3
Total	1,692	483	96	1,113	867	622	139	106	81	165

1/ Includes graduates which entered the armed forces, continued full-time school and those with other reasons for not entering the labor force.

Source - Department of Education: Follow-up of Enrollees in Preparatory Vocational Education Programs (Form OE 4045) Fiscal Year 1969

TABLE IV-3
EMPLOYMENT STATUS OF THE
CIVILIAN NONINSTITUTIONAL POPULATION, BY SEX
December 1969 – January 1970
(thousands of persons 16 to 21 years)

Employment Status	Both Sexes			Male			Female		
	Jan. 1970	Dec. 1969	Jan. 1969	Jan. 1970	Dec. 1969	Jan. 1969	Jan. 1970	Dec. 1969	Jan. 1969
Civilian Noninstitutional Population	343	342	340	173	173	172	170	169	168
Labor Force	110	105	111	75	71	76	35	34	35
Employed	76	80	79	50	52	51	26	27	28
At work	72	77	76	48	51	49	24	26	27
With a job but not at work	4	3	3	3	*a*	2	*a*	*a*	*a*
Unemployed	34	26	32	25	19	25	9	7	7
Unemployment rate*	30.9	24.4	28.8	32.9	26.8	32.8	26.6	19.5	20.2
Not in the Labor Force	232	236	229	98	101	96	134	135	133
Keeping house	56	57	60	*a*	*a*	*a*	56	57	59
At school	157	153	149	80	81	77	77	78	72
Unable	3	3	3	2	3	2	*a*	*a*	*a*
Others	16	17	17	15	18	16	*a*	*a*	*a*

*Percent of the labor force

a Not enough cases in the sample for a reliable estimate.

Source: Puerto Planning Board, Bureau of Social Planning

(8) hourly earnings before vocational school training, (9) total earnings before vocational school training, (10) total net earnings or total earnings after vocational training minus total earnings before vocational school training.

We have not taken into consideration the earnings of graduates who joined the military armed forces. In our analysis we have included only those benefits accruing to a person who is in the civilian labor force.

Generally, we have assumed that graduates with vocational school training will have higher earnings and more stable employment than individuals without such training. By higher earnings and stable employment a worker is assumed to have greater job satisfaction and better morale, which in turn represents an increase in the total utility to be gained from the training course which the graduate received at the vocational school.

BENEFITS TO THE INDUSTRY

A vocationally trained graduate is employable within a short training period of few months. Nonvocationally trained graduates, however, require much lengthier training for the same job. Thus, in shortening significantly the training period for which the employer pays, the vocational training program reduces the employer's cost thus increasing his production and profits. In addition, it may be noted that a vocationally trained graduate not only has specialized training for a specific occupation, but should also have better discipline and work habits, thus reducing nonproductive behavior, e.g., misuse of machinery.

Vocational school training furnishes an individual the basis for a wider range of job possibilities, thus increasing his occupational mobility. The greater the occupational mobility and adaptability, the more efficient will be the adjustment of demand and supply for skills; by implication there will be greater employment stability for the vocationally trained person as

compared to the nonvocationally trained person. Thus, vocational training increases industry's income and improves the employee's income stability.

BENEFITS TO GOVERNMENT FROM VOCATIONAL TRAINING

Benefits to the Government from vocational training accrue in the following two ways: (1) increase in tax and nontax revenues, (2) reduction in welfare payments and related expenditures. A vocationally trained person, as pointed out above, has higher income and greater stability of job as compared to a nonvocationally trained person.

The income of the vocationally trained person is subject to all the taxes in the fiscal system of the Government of Puerto Rico: personal income tax, excise taxes, customs duties, property taxes, etc. The income of the vocationally trained graduate in many cases may not be sufficiently high to be subject to personal income tax. However, the vocationally trained graduate must pay taxes on goods and services which he consumes in a particular year. Like any other citizen, if he smokes, drinks beer or rum, or uses electrical appliances, he must pay excise taxes. If he uses an automobile, he must pay the automobile excise tax and tax on gasoline. If he uses a foreign automobile, he must pay import duty to the Federal Government which is turned over to the Government of Puerto Rico. If he owns a house, he may have to pay property tax.

It has been estimated by the Department of the Treasury of the Government of Puerto Rico that the burden of taxes on different income brackets differs considerably from one income bracket to another. Generally, young people with vocational school training entering the labor market, have incomes of $1,300 to $6,000, a range subject to a tax of 10 to 13 per cent.

Secondly, the vocationally trained graduate helps to increase industrial income, which is subject to corporate or personal income tax, depending on the business. If the business is exempt from income tax, it does not contribute during an exempt period to the Government of Puerto Rico. However, most businesses in Puerto Rico do pay taxes, including income tax, property tax, patents, etc.

Thirdly, each job occupied by a vocationally trained graduate creates another job through the multiplier effect of income. The vocationally trained graduate receives salaries and wages and when he spends this income for purchasing food, clothing, shoes, electrical appliances and other necessities of life, he creates an additional job. This job in turn increases income and generates revenues to the Government.

Fourthly, when a vocationally trained graduate completes his training he has greater chances of getting a job. According to the January survey, of the 6,940 vocationally trained students in the labor force, 84 per cent were full-time or part-time employed and about 16 per cent were unemployed.

As indicated earlier, there is a very high rate of unemployment among the young without vocational school training. On the other hand, there is a tremendous shortage of workers in certain skilled occupations.

A report entitled "Comprehensive Manpower Plan - Fiscal year 1971, Part A," provides information on occupational shortages in Puerto Rico, most of which exist in areas included in the curricula of the Vocational School Program.

The report says that "these occupations continued to be in demand in the Commonwealth during fiscal 1970: Comptroller specialized in data processing, Chemist, Commercial Education Teacher, Social Worker, Engineer, Electrician, Automobile-Body Repairman, Sheet-Metal Worker, Forelady Sewing

Room, Sewing Machine Operator, Television-Serviceman and Repairman, Cabinet-maker, Offset Pressman, Embroidery-Machine Operator, Tool-and-Die Maker, Alteration Tailor, Machine Cutter, Applique Cutter, Furniture Upholsterer, Diamond Cutter, Plater, Stone Setter, Sewing-Machine Repairman, Maintenance Mechanics, Ornamental-Metal Worker, Wax Molder, Baker, Meat Cutter, Waitress, Live-in-Maid, Salesperson (hardware and automobile parts), Saleslady for exclusive stores with special requirements, Reservation Clerk with experience and bilingual college education level for airline ticket agencies, Insurance Salesman on a commission basis, Bookkeeper, Dictaphone Operators, Teletype Operators and Secretaries in the high and intermediate level.

"In the health field: Medical Laboratory Assistant, Dental Laboratory Technician, Dental Hygienist, Radiologic Technologist, X-Ray Developing Machine Operator, Surgical Technician, X-Ray Equipment Tester, Orthopedic Cast Specialist, Orthopedic Technician, Inhalation Therapist, X-Ray Technician, Medical Records Librarian, Medical Secretary, Dental Assistant, Physiotherapist and Physioterapist Assistant, Health Educator, Pharmacist, and Registered and Practical Nurse.

"Workers are being sought to staff existing social welfare, health, education, training agricultural, and other programs. The continued shortage of qualified personnel endangers the success of some programs and complicates the organization of new ones such as those that deal with manpower problems, urban growth, rural areas, and economic development. The critical occupations as reported by the Office of Personnel are: Biologist, Food Technologist, Bacteriologist, Chemist, Communication Technician, Cytotechnologist, Dentist, Draftsman Architectural, Engineers (all kinds), Dietitian, Economist, Mental Health Educator, Electrician, Hearing and Speech Therapist, Illustrator, Laboratory Technician, Nurse, Nutritionist, Pharmacist, Physical Therapist, Physician, Plumber, Radio Operator, Social Worker, Sociologist, Statistician,

Surveyor, Systems Programmer, and Urban, Social, Regional and Economic Planner. Around 30 occupations in the graphic arts field were also critically short. These included Proofreader, Bookbinder, Stenotypist, Photoengraver and Linotypist."

Thus, it can be seen that the vocationally trained graduate has a higher probability of finding a job compared to the nonvocationally trained graduate, particularly when there are shortages in occupations for which vocational school curricula especially prepares young entering the job market.

Higher rates of employment reduce the expenditures of the Government on social services, welfare payments, police and maintenance of law and order. The Government incurs millions of dollars of expenditures on welfare payments; it provides health services for destitute families and provides housing facilities to families with relatively low incomes. Thus, by creating skills which are employable, vocational school training programs make a person less dependent on the Government and more self-sufficient.

Elsewhere, the studies which have been conducted show that an employed person is less likely to engage in activities which could classify him as antisocial. For example, he is less likely to commit auto thefts or use drugs. To the extent that nonsocial activities are reduced by the vocational training school program, the program helps to reduce the expenditure of police, courts and jails. For example, it has been estimated for the United Kingdom that each crime costs the Government approximately $8,000 a year in time spent by various agencies dealing with law and order. This amount is probably equal or even larger in Puerto Rico.

VOCATIONAL SCHOOL PROGRAM AND GROSS PRODUCT

The income of individuals and the income of industry are part of the gross product of Puerto Rico. Such income generates a multiplier effect

of one to one every year. Thus, the direct and indirect income generated by the vocational school training program is income which accrues to the society of Puerto Rico at large.

DETERMINATION OF COSTS

Data for 1969-70 in this report pertain to actual expenditures, which in turn were divided into direct costs and indirect costs.

Direct costs are defined as the costs which can be directly identified with a particular course, such as salaries, equipment, buildings and maintenance. When expenditures could be identified for a specific program they were included as direct cost.

Indirect costs are defined as expenses incurred on a particular program. When such data was available it had to be broken down by courses. Such indirect costs may include salaries and wages, purchase of equipment, buildings, maintenance, furniture and fixtures, administration, etc.

Overhead expenditure is defined as that which directly or indirectly can be attributed to either a program or a course. Example of such an expense would be the salaries and expenses of the Office of the Assistant Secretary of Vocational School Programs, plus a proportion of the expenditures of the Department of Education, such as rental of buildings, maintenance, administrative cost of the accounting office, etc.

Direct and indirect cost data was provided to us by the Evaluation and Statistics Division of the Vocational Education Program and by the Budget Office of the Department of Education. The Division of Property furnished information on furniture, equipment, machinery, etc. and the Department of the Treasury furnished the data on buildings, construction and improvements.

The Vocational School Program itself has individual budgets for only three programs: Home Economics, Health, and Technical.

The Office of the Budget of the Department of Education has computer tabulations which include data on various programs and items of expenditure by program. From these data it was possible to deduce the direct cost of different programs. The direct cost was then attributed to courses. The data available from the Office of the Budget permits us to assign a specific item of expenditure to a specific course. The data so collected by item and course was then processed by the Computer Division of the Department of Education. By this method the cost by courses was properly identified, and the data on direct expenditures by courses was then used to arrive at the direct cost by program.

The data on direct costs by schools was identified with the help of data available on items of expenditures by courses and by schools within the Office of the Budget of the Department of Education. However, the Office of the Budget provided data only on current costs and did not have data on capital costs. The data on capital costs was obtained from the files of the Department of the Treasury.

The cost data on courses and schools was then used to ascertain the cost data by districts. Individual school data pertaining to current and capital expenditures was collected manually. Data by courses covering both current and capital costs was fed into the computer, with the results providing direct capital cost by schools and distributed manually by courses in the following manner: determination of sessions per course, number of classrooms and number of teachers. A weighted proportion of these three factors was applied to the total direct capital cost. To each session was given a weight of 1, to each teacher a weight of .5 and to the number of classrooms utilized per session a weight of 1. A session is the time used by a teacher in a specific course, which may happen more than once in a day, and may last one hour or three hours and the hours may be continuous or at intervals.

We had the data available on number of teachers, number of classrooms and number of sessions. These data were used to determine the total number of weights. On the basis of these weights, the direct cost data bearing on salaries and wages, books and materials, maintenance, buildings and improvements, etc., were distributed to find out the total direct cost per course. However, it may be noted that the weights were not used to the following items of expenses: buildings, equipment, furniture, and fixtures.

There are two types of courses being conducted by the Vocational School of the Department of Education. First, are courses oriented toward preparing the students to perform specific skilled jobs when they leave school. Secondly, are courses which can be defined as nonoccupationally-oriented. These are essentially designed to improve the level of living of the families or of individuals so that relationships at home can become more congenial and stable. Such courses are more of a sociological than an economic nature, since they are essentially geared to upgrading the quality of life of the student, his relatives, and the community at large. It may be noted that nonoccupationally-oriented vocational courses were predominant in the programs of Home Economics and Industrial Arts. However, such courses were also used extensively in the program of Health.

Expenditures are incurred in occupationally-oriented courses and nonoccupationally-oriented courses. The data available from the Vocational School Program permits the classification of costs for these two types of vocational courses, under the headings of useful and gainful. Useful is co-related with occupation-oriented courses and gainful is identified with the nonoccupation-oriented courses.

The basis for determination of cost data by occupation-oriented and nonoccupation-oriented stems from the Annual Report structure submitted

by the Vocational and Technical Training Division to the Office of Education in Washington - HEW. This data is broken down thru the individual expenditure reports submitted for each program, and is kept on file by the Office of the Budget of the Department of Education.

Capital expenditures were incurred on the construction of a number of schools to provide educational facilities to vocational students, as well as to nonvocational students. Vocational students were given a certain number of courses and thus a number of classrooms were used. On the basis of ratio of classrooms designated for vocational school programs and for nonvocational school programs, the capital costs were allocated between vocational education and nonvocational education.

Although it was difficult to identify indirect cost by courses, indirect cost data was available at the program level. Then, to identify indirect costs by courses we used the raw data which was available in a summarized form by program, such as: salaries, equipment, administration, books and materials. A formula was designed to allocate program costs by courses. The formula is as follows:

Direct cost by Subject ÷ Total Direct Cost by Program x Total Overhead = Overhead by Program.

For example, overhead costs were distributed first by programs and then the data obtained by programs was distributed by courses.

To the overhead total by program we applied the first formula described above and the results was the distribution of indirect cost overhead by courses.

The proportion of indirect cost to direct cost is unusually high because of the detail into which program budgets are broken down within the Department of Education and Vocational Education Program, factor which prevents refined analysis of all cost data.

DEPRECIATION

Essentially, a straight-line method was used to ascertain the capital expenditure on buildings and other equipment which could be allocated to 1969-70. For example: Concrete-constructed schools were given a life of 30 years and wooden schools were given a life of 10 years. All the schools which were not written off under the above two assumptions in 1969-70, were subjected to a necessary ratio with a view to find out the depreciation weights. It may be noted that most of these ratios correspond to the ratios being used by the Commonwealth Bureau of Income Tax and Federal Internal Revenue Service.

V - COST AND BENEFITS OF VOCATIONAL EDUCATION BY PROGRAMS

The particular socio-economic conditions of Puerto Rico require that various skills and human resources be provided in order for economic growth to continue and social justice to improve. Skills provided through the vocational education system affect the individual trainee, the Government and the society. For an individual, an important function performed by vocational education is that it makes him an economically productive person, the direct evidence of which is reflected in his earnings and ability to be employed. An improvement in wage and salary rates of an individual increases the tax base and tax revenues. Improved skills reduce the likelihood that the individual will be in need of welfare payments or other forms of assistance such as low cost housing or hospitalization for indigent population. A stable source of employment helps reduce unemployment and the need for services for the unemployed.

Increase in tax revenues and reduction in welfare services and payments have very positive effects for the society of Puerto Rico and the Government. The positive effects are drawn from the real economic benefits, in the form of increased goods and services to the society. From the positive economic effects, the Government derives revenues and reduces expenditures, which in turn offset any additional costs of vocational education programs.

Vocational education programs provide training to young people, who in turn supply the necessary skills for industry, commerce and finance. Without the availability of such skills, businesses would not be able to operate efficiently in an economic sense.

The society of Puerto Rico is rapidly changing, with one of the highest economic growth rates in the world. Old industries are becoming obsolescent as new industries operating with modern technology are expanding. Some skills are becoming obsolete while other are in increasing demand. The vocational education program is necessary to provide personnel to answer the demands of advancing technology since the vocational school system provides facilities for training and retraining personnel.

SYSTEM OF VOCATIONAL EDUCATION IN PUERTO RICO

Vocational education programs of the Department of Education are designed to equip young people and adults with salable skills. The system consists of seven secondary vocational schools, eight superior schools with vocational departments, 376 secondary schools with vocational programs, and two technological institutes. In addition, under the system a number of training centers have been established in various municipalities.

The system of vocational educations has the following subprograms:

- Vocational Agriculture
- Distribution and Marketing
- Home Economics
- Office Occupation
- Trade and Industry
- Cooperative Industry Occupation
- Technical Education
- Human Resources and Industrial Arts
- Health

These programs provide two types of training:

1. Training designed to improve the way of living.

2. Training designed to improve skills and as a consequence standards of living.

In this report, the first type of training has not been discussed. However, all the programs designed to improve salable skills have been thoroughly analyzed.

There were 59,007 students enrolled under the salable skills programs of the vocational education system in 1969-70. Of these, 26,500 graduated by May, 1970. There were 2,805 dropouts and the remainder continued their training programs. The details of enrollment, dropouts and graduates by programs are shown in Table V-1.

TABLE V-1

ENROLLMENT BY PROGRAMS IN VOCATIONAL EDUCATION SYSTEM

Program	Total Enrollment	Drop-outs	Graduates
Agriculture	4,705	24	845
Distribution	9,781	119	8,690
Health	1,118	30	723
Home Economics	2,597	300	2,310
Office Occupations	17,845	720	4,023
Trade and Industry	18,110	935	7,206
Cooperative Industry Education	725	39	294
Technical	1,583	153	371
Human Resources Industrial Arts	2,543	485	2,038
Total	59,007	2,805	26,500

COST OF VOCATIONAL EDUCATION

In 1969-70 the expenditure on training programs for salable skills amounted to $23.5 million and, approximately $4 million for programs designed to improve the way of living. The expenditures for subprograms are given in Table V-2.

The table shows that the largest expenditures were incurred in Trade and Industry programs and the smallest were incurred in Human Resources and Industrial Arts programs. The Home Economics program was allocated 13.5 per cent of total expenditures and Office Occupations program was 12.5 per cent of the total expenditures.

Analysis of program expenditures by objects shows that the largest percentage of expenditures was incurred on salaries, with 48.8 per cent, or almost one-half, of the total expenditures. Administrative expenditures were approximately 14.8 per cent of total expenditures; books and materials - 4.1 per cent; maintenance - 3.7 per cent; building and improvements - 5.7 per cent; expenditures on overhead were 10.5 per cent.

While these are the overall averages of expenditures by objects, individual programs had significant variations in the combination of expenditures. For example, Trade and Industry allocated 63.7 per cent of its total expenditures for salaries and wages while the Technical program allocated 28.7 per cent of total expenditures for this same purpose. While the Cooperative Industry Education program spent 7.1 per cent of its allocation on books and materials, the Technical program spent only 1.1 per cent on books and materials. Administrative expenditures on the Technical programs were very high at 34.2 per cent as compared to 5.4 per cent allocated to the programs of Office Occupations and Trade and Industry. Similarly, there was a significant variation in expenditures allocated to equipment, furniture and fixtures.

TABLE V-2

VOCATIONAL EDUCATION EXPENDITURES BY SUB-PROGRAM

SUB-PROGRAM	EXPENDITURE ($000)	PER CENT OF TOTAL
Agriculture	$ 2,057	8.8
Distribution	1,520	6.5
Health	2,568	10.9
Home Economics	3,178	13.5
Office Occupation	2,930	12.5
Trade & Industry	6,123	26.1
Cooperative Industry Educ.	1,715	7.3
Technical	1,965	8.4
Human Resources, Industrial Arts	1,419	6.0
TOTAL	$23,476	100%

While the Health program spent 2.4 per cent of the allocation on equipment, furniture and fixtures, 23 per cent of the Cooperative Industry allocation was for this purpose. The details are shown in Table V-3.

One of the very significant difficulties in analyzing the expenditures was defining direct costs and indirect costs. The direct costs, as pointed out elsewhere, were defined as the costs directly identified for a particular course, such as salaries, equipment, buildings, maintenance, etc. This means that when an expenditure could be idendified for a specific course, it was included under direct costs. On the other hand, when costs were incurred on programs in the form of overhead or central administration and could not be assigned to a particular course, they were defined as indirect costs. In many cases such indirect costs included salaries and wages, purchases of equipment, furniture and fixtures, maintenance and improvement of buildings, and overall administration.

It has been estimated that of the $23.5 million dollars of expenditures incurred in 1969-70, only $5.8 million could be identified as direct expenditures. On the other hand, indirect expenditures amounted to $15.2 million and in addition, overhead expenditures amounted to $2.5 million. For this reason, uncertainty arises regarding the costs of various programs--since individual program costs cannot be identified exactly and can only be classified as indirect cost expenditures, it is difficult to know how exact the estimates of individual program costs are. In the absence of exact data, estimates have been made using a number of assumptions. While we utilized the best methods available in estimating indirect costs by courses, there is no doubt that there is room for improvement in this area, particularly when indirect costs amounted to almost 2/3 of the total cost. This type of expenditure requires a better format

for identification and classification. Since the type of information system which provides exact data on programs or courses is not generally available, it is recommended that such a system be produced under the Management Information System concept and designed for the vocational school program of the Department of Education.

Indirect costs varied sharply from program to program. While Distribution and Marketing program had 50.3 per cent of total costs in the form of direct expenditures, the Health program had only 5.5 per cent. On the other hand, indirect costs were very high in the case of the Health program where they amounted to 77.5 per cent of total expenditures. While there is uncertainty and inexactness in the direct and indirect cost data, this does not mean that data cannot be used for appropriate analysis.

BENEFITS

There are two types of benefits: individual benefits accrue to the vocational school graduates and social benefits accrue to the society at large, industry, and business. Benefits accrue to an individual and to society in the future, while most of the costs are incurred presently. To the extent that benefits accrue in future years, they must be made comparable to the costs. Such a comparison is possible by adjusting the future benefits and translating them to the present value with the help of the discount rate.

Individual benefits accrue because vocational school training permits an individual to earn higher wages and salaries than would be possible without such training. With the help of the Department of Labor data, supplemented by a survey conducted by the Department of Education, we have arrived at the conclusion that wage rates vary significantly from occupation to occupation and from one type of program to another type of program. In the area of farming, wages are low at 95¢ per hour. On the

TABLE V-3

BASIC EXPENSE ITEMS AS PERCENTS OF TOTAL COST BY PROGRAMS

(Stated in %)

	Salaries	Books & Materials	Administration	Maintenance	Building Improvements	Equipment Furniture & Fixtures	Other	Overhead	Total
Agriculture	55.4	2.[illegible]	[illegible].3	2.3	3.7	[illegible].4	16.7	3.6	100.0
Distribution	50.[illegible]	[illegible].[illegible]	[illegible].5	4.2	7.0	[illegible].8	2.9	12.[illegible]	100.0
Health	33.[illegible]	4.3	33.2	2.8	4.7	2.4	1.9	17.1	100.0
Home Economics	31.0	4.4	29.[illegible]	4.0	5.3	7.2	1.9	16.4	100.0
Office Occupations	[illegible]2.[illegible]	4.[illegible]	[illegible].4	3.4	5.0	[illegible].[illegible]	5.8	4.[illegible]	100.0
Trade and Industry	[illegible]3.[illegible]	4.1	[illegible].4	3.4	4.[illegible]	[illegible].7	6.4	[illegible].5	100.0
Cooperative Industry Education	35.[illegible]	[illegible].1	[illegible].[illegible]	[illegible].0	12.4	23.1	2.6	[illegible].0	100.0
Technical	28.[illegible]	1.1	34.2	3.2	4.[illegible]	5.1	.7	22.[illegible]	100.0
Human Resources - Industrial Arts	55.[illegible]	3.2	[illegible].[illegible]	5.4	[illegible].4	5.[illegible]	1.0	12.[illegible]	100.0
Totals of All Programs	[illegible]5.[illegible]	4.[illegible]	14.[illegible]	3.[illegible]	5.7	[illegible].[illegible]	4.8	10.5	100.0

other hand, wages for programmers are $3 per hour. The details of earnings by different occupations are given in Table V-5.

This table also includes the full-time or part-time earnings by occupations, 2,080 hours per year being considered full-time and 1,040 hours part-time. Thus, a person working in agriculture on the basis of 2,080 hours per year would be earning $1,976 and a person working as a programmer would be earning $6,240. It may be noted that wages of an agricultural worker may be somewhat overstated in the table due to the fact that agriculture has seasonal employment which generally lasts from 4 to 6 months of the year. The rest of the months the worker is either unemployed or engaged in urban occupations.

In order to find out how much a vocational school graduate earns under the program of Agriculture or other programs, we selected a number of occupations and used the corresponding wage rates to determine earnings of a worker during the twelve-month period.

It has been estimated that total benefits received by 1969-70 graduates from salaries and wages amounted to $58.4 million on a twelve-month basis. The single most important program contributing to total individual benefits was the program of Distribution at $22.4 million and the second most important program was Trade and Industry which contributed $15.3 million. The program of Agriculture contributed the lowest amount, at $1.1 million.

Substantial benefits accrue to full-time employed individuals, and only to a minor extent to the part-time employed vocational school graduates. The number of part-time graduates is much lower than full-time graduates and earnings of part-time graduates are assumed to be 50% of full-time graduates. Full-time and part-time benefits by programs are shown in Table V-6.

TABLE V-4

DIRECT, INDIRECT & OVERHEAD EXPENDITURES BY SUB-PROGRAMS, 1969-70

Sub-Program	Total	Direct	% of Direct to Total	Indirect	% of Indirect to Total	Overhead	% of Overhead to Total
Agriculture	$ 2,056,831	$ 444,449	21.6	$ 1,536,669	74.7	$ 75,713	3.7
Distribution	1,520,312	763,557	50.3	564,644	37.1	192,111	12.6
Health	2,667,694	134,377	5.5	1,889,316	77.5	438,282	17.0
Home Economics	3,179,350	428,266	13.5	2,229,556	70.1	521,528	16.4
Office Occupations	2,424,499	713,827	24.4	2,073,506	70.8	142,342	4.8
Trade and Industry	4,123,100	1,416,292	31.3	3,806,619	62.2	400,189	6.5
Cooperative Industry Education	1,715,468	764,349	44.6	865,089	50.4	86,033	5.0
Technical	1,945,594	144,618	8.4	1,362,579	69.3	438,342	22.3
Human Resources, Industrial Arts	1,418,837	427,815	30.2	811,343	57.2	179,679	12.6
Total	$23,475,805	$5,773,642	24.6	$15,238,427	64.9	$2,474,259	10.5

TABLE V-5

WAGE RATE PER HOUR AND PER YEAR BY OCCUPATION, 1969-70

Occupation	Rate Per Hour	2080 hours: Full-Time Employed	1040 hours: Part-Time Employed
Draftsman	$1.50	$3,120	$1,560
Medical Assistant	1.60	3,328	1,664
Electronic Technician	1.75	3,640	1,820
Floral Designer	1.45	3,016	1,508
Programmer Eng. Scientist	3.00	6,240	3,120
Secretary	2.47	5,130	2,569
Stenographer	2.08	4,326	2,163
Clerk Typist	1.60	3,328	1,664
Bookkeeper II	1.85	3,848	1,924
Service Clerk	1.67	3,474	1,737
Baker	1.25	2,600	1,300
Cosmetologist	1.40	2,912	1,456
Farmer General	.95	1,976	988
Auto Mechanic	1.60	3,328	1,664
Cabinet Maker	1.60	3,328	1,664
T. V. Service Repairman	1.40	2,912	1,456
Dressmaker	1.10	2,288	1,144
Electrician	1.60	3,328	1,664
Carpenter	2.29	4,576	2,288
Plumber	1.60	3,328	1,664

Source: Department of Labor: Wage and Salary Division

TABLE V-6

DIRECT BENEFIT FROM VOCATIONAL TRAINING BY PROGRAMS BY PART-TIME AND FULL-TIME EMPLOYED

PROGRAM	Total Benefits	% of Total By Program To Total	Part-Time Employed Benefits	Full-Time Employed Benefits	% of Full-Time to Total By Program
Agriculture	1,105,274	1.9	53,771	1,051,503	95.1
Distribution	22,415,826	38.4	643,749	21,772,077	97.1
Health	1,934,672	3.3	68,811	1,865,861	96.4
Home Economics	3,604,782	6.2	317,594	3,287,188	91.2
Office Occupations	6,674,070	11.4	826,091	5,937,979	89.0
Trade and Industry	15,266,636	26.1	1,001,800	14,264,836	93.4
Co-Operative Industry Educ.	732,694	1.3	33,865	698,829	95.4
Technical	1,223,971	2.1	13,151	1,210,820	98.9
Human Resources Ind. Arts	5,400,283	9.2	250,312	5,149,971	95.4
TOTAL	58,448,283	100.0	3,209,144	55,239,064	94.5

UNIT BENEFITS AND COSTS

In previous sections, we have provided analysis and data on benefits and costs by programs. If we divide the data on benefits and costs by the corresponding number of graduates, we can obtain unit benefits and unit costs by programs.

The unit benefit cost data given in Table V-7 was used to obtain benefit:cost ratio. The benefit:cost ratio equals the present value of benefits divided by the present value of cost. As a general rule, when the benefit:cost ratio exceeds unity, the corresponding activity is economically superior to an alternative activity with a lower benefit:cost ratio. If purely economic criteria are to be used in determining the decision on vocational expenditures, then the programs chosen first should be those having the highest benefit cost ratio. Similarly, some researchers, such as Bruce Davie,[1/] are of the opinion that programs having a benefit ratio less than one should not be undertaken. In addition to Davie, Mr. Einar Hardin[2/] cautioned that the decision-maker may elect to consider additional criteria of a noneconomic nature in the decision-making process.

1/ Davie, Bruce F. "Benefit/Cost Analysis of Vocational Education: a Survey." In Arnold Kotz (Ed.), Occupational Education: Planning and Programming. Volume Two. Menlo Park, Calif.: Stanford Research Institute, September, 1967, Pp. 309-330.

Davie, Bruce F. "Cost-benefit Analysis of Vocational Education: A Survey." In Hearings Before The General Subcommittee on Education of the Committee on Education and Labor, House of Representatives Ninetieth Congress, First Session, on H.R. 8525 and Related Bills, A Bill to Amend the Vocational Education Act of 1963. Part 1. Washington, D.C.: U.S. Government Printing Office, 1968, Pp. 105-117.

2/ Hardin, Einar. "Summary Guide for Effectiveness/Cost and Benefit/Cost Analyses of Vocational and Technical Education: A Report of the Conference." In Arnold Kotz (Ed.), Occupational Education: Planning and Programming. Volume Two. Menlo, Calif.: Stanford Research Institute, September, 1967, Pp. 379-386.

Benefit:cost ratio is more than unity for the programs of Distribution and Marketing, Home Economics, Office Occupations, Trade and Industry program, and Human Resources and Industrial Arts. For Cooperative Industry Education, Technical programs, Agriculture, and Health, benefit:cost ratios are less than unity. The reason that four programs have benefit:cost ratio less than unity is that only one year is being used as the source of benefit to the individual. However, if about two years are used, then benefit:cost ratio in almost all the programs will be more than unity. It may be noted that it is not realistic to use one or two years as source of benefits to individual as stated elsewhere. Generally, a vocational school graduate leaves the school when he is about 20 years old. Presently, the working life of an individual generally is up to the age of 65. This means that he has a working life of 45 years and thus the benefits to him as well as to the society will accrue over all these years. The future benefits, however, are discounted to give them a present value.

TABLE V-7

RATIO OF BENEFIT TO COST BY PROGRAMS

Program	Graduates	Total Benefits	Total Costs	Unit Benefits	Unit Costs	Benefit:Cost
Agriculture	845	1,105,274	2,056,831	2,284	4,240	.54:1
Distribution	8,690	22,415,826	1,520,312	2,579	175	14:1
Health	723	1,934,672	2,567,656	2,676	3,551	.75:1
Home Economics	2,310	3,604,782	3,178,350	1,560	1,376	1.1:1
Office Occupations	4,023	6,764,070	2,929,695	1,681	728	2.3:1
Trade and Industry	7,206	15,266,636	6,123,100	2,118	850	2.5:1
Cooperative Industry Education	294	732,694	1,715,468	2,492	5,835	.42:1
Technical	371	1,223,971	1,965,556	3,299	5,298	.62:1
Human Resources, Industrial Arts	2,038	5,400,283	1,418,837	2,650	696	3.8:1

MULTIPLIER EFFECTS OF BENEFITS FROM VOCATIONAL EDUCATION

In an earlier section we have estimated the total benefits and benefits by programs from vocational education. These estimated benefits are considered to be the direct benefits. These are the benefits which accrue only to an individual trainee himself and do not include all the benefits accruing to society at large.

It has been estimated that total benefits to individual graduates from the vocational school program amounted to $58.4 million within 12 months of the graduates' employment. Using the multiplier effect it is estimated that total benefits accruing to the society at large amounted to $116.9 million. This sum of $116.9 million includes both direct benefits and indirect benefits. The indirect benefits accrue to the society by the fact that each dollar of income accruing to a technical vocational graduate when spent on different goods and services creates another job and another dollar of income for the workers who are part of the labor force of Puerto Rico. This ratio of direct to indirect benefit of 1:1 is the standard ratio used by the Puerto Rico Planning Board and the Economic Development Administration in the estimation of income and jobs. The details of direct benefits and total social benefits including the multiplier effect are shown in Table V-8. It may be noted that the sum of $116.9 million represents 3.2 per cent of the 1970 net income of Puerto Rico.

TABLE V-8

TOTAL AS UNIT BENEFITS WITH MULTIPLIER EFFECT

	Without Multiplier Effect		With Multiplier Effect			
	Total Benefits (000 of $) (1)	Unit Benefit ($) (2)	Total Social Benefits (000 of $) (3)	Unit Social Benefit ($) (4)	Unit Cost ($) (5)	Unit Social Benefit:Cost Ratio (6)
riculture	$ 1,105	2,284	$ 2,210	4,568	4,240	1.08:1
stribution	22,416	2,579	44,832	5,158	175	28:1
alth	1,935	2,676	3,870	5,352	3,551	1.5:1
me Economics	3,605	1,560	7,210	3,120	1,376	2.2:1
fice Occupation	6,764	1,681	13,528	3,362	728	4.6:1
ade and Industry	15,267	2,118	30,534	4,236	850	5:1
operative Industry Occupation	733	2,492	1,466	4,984	5,835	.84:1
chnical	1,224	3,299	2,448	6,598	5,298	1.24:1
man Resources Industrial Arts	5,400	2,650	10,800	5,300	696	7.6:1
	$58,449		$116,898			

TOTAL SOCIAL BENEFITS AND UNIT COST RATIO

Table V-8 provides the data on unit costs which vary from $175 in the case of a graduate of the Distribution program to $5,835 under the Cooperative Industry occupation program. The unit costs for other programs are given in Table V-8, which also provides the data on unit social benefits. The unit social benefits are defined as the summation of direct and indirect benefits, divided by the number of graduates. The unit social benefits varied from $3,120 in the case of Home Economics to $6,598 in the Technical program. The unit social benefits for other programs are within this range.

A comparison of ratio of unit social benefits to unit cost, is given in Column 6 of Table V-8. It may be seen from this table that the ratios are as high as 28:1 and as low as .84:1. It may be noted that it is only in the case of the Cooperative Industry occupation program that the ratio of benefit to cost is less than unity. In all other cases, the ratio of benefits to cost is higher than one and in the case of Distribution, Office Occupations, Trade and Industry and the program of Human Resources and Industrial Arts, the benefits ratio is significantly higher than one. Even in the case of the Agriculture program where wage rates are lower than in those occupations generally associated with urban economic and social activity, the ratio of unit social benefit to cost is higher than unity. It should be emphasized that these ratios are computed from benefits accruing over a period of only 12 months of work. When computed over an individual's 45 working years, obviously, the benefits will be much higher than the cost.

VALUE OF DISCOUNTED FUTURE BENEFITS

While the costs are incurred presently, the benefits from vocational school programs accrue to an individual and the society over a number

of years. The problem exists in the need to express streams of future benefits to comparable present values. As a whole, both the individual and the society acting collectively place a higher value on present benefits than on future benefits, or on the present cost of future benefits. Students of economics have devoted considerable time and effort in determining the appropriate social time preference discount rate which could be applied in cost benefit analysis. While the problem has not been resolved to the sstisfaction of all, one solution has been sought using an interest rate which an individual has to pay to borrow a certain amount of money from the commercial banking system. Some economists have felt that the discount interest rate should be equal to what the Government paid for its public debt, and others have argued for some combination of both the private rate of interest and the Government rate of interest. We have combined the private rate of interest and the public rate of interest and, therefore, have used an interest rate of 7 per cent per year to discount benefits which will accrue in the future years.

Benefits to the society and to an individual will accrue correspondingly to the wage rates for different occupations and skills. During the past five years, wage rates have been rising at the rate of 10 per cent per year. We assume that these wage rates will continue to increase at that rate over the next five years. Thus, an occupation receiving a wage of $1 per hour in the current year will receive a benefit of $1.10 next year and $1.61 in the 5th future year.

Based on increase of wage rates and discount rates, we have developed an index of present value of discounted future benefits. This index is based on 10 per cent increase in wages and salaries per year and 7 per cent discount for reducing future benefits to present value. The index is given in Table V-10. Thus, based on these two variables of wages and discount rates we have arrrived

TABLE V-9

WAGE RATES FOR VOCATIONAL AND NONVOCATIONAL EDUCATION

	Wage Per Hour (1)	Wage Per Hour At 60% (2)	Wage Per Hour At 60% + 20¢ (3)	Attributed To Non-Vocational Education (4)	Vocational Education (5)
Agriculture	$0.95	$0.57	$0.77	81.0%	19.0%
Distribution	1.67	1.00	1.20	71.9	28.1
Health	1.60	0.96	1.16	72.5	27.5
Home Economics	1.20	0.72	0.92	76.7	23.3
Office Occupation	2.00	1.20	1.40	70.0	30.0
Trade and Industry	1.75	1.05	1.25	71.4	28.6
Cooperative Industry Occupation	1.50	0.90	1.10	73.3	26.7
Technical	1.50	0.90	1.10	73.3	26.7
Human Resources Industrial Arts	1.40	0.84	1.04	74.3	25.7

NOTES:

1/ Column (1) corresponds to wage rate approximating the related occupation.

2/ Columns (2) and (3) are based on the following assumptions:

a) That an apprentice is paid about 60% of standard minimum wages and he receives an increment of $.10 every three months. We assume it would be fair to use $.20 per hour of increment of wages. The date was obtained from the Department of Labor.

3/ Column (4) is obtained from columns (3) and (1) and column (5) by simple deduction, that 100.0% minus column (3)

Source: Basic data was obtained from the Department of Labor.

at the conclusion that the index for next year will be 102.9 and in the graduate's 6th year of work the index will be 115.3.

TABLE V-10

INDEX OF PRESENT VALUE OF DISCOUNTED FUTURE BENEFITS

	Growth in Wages and Salaries (10.1%) Index	Discounted Future Benefits at 7% Per Year Index	Present Value of Discounted Future Benefits
2nd year	110.1	93.5	102.9
3rd year	121.2	87.3	105.8
4th year	133.5	81.6	108.9
5th year	146.9	76.3	112.1
6th year	161.7	71.3	115.3
			5/545.0
			109.0

The index developed in Table V-10 has been used to estimate the present value of discounted future five-year benefits. The results are shown in Column 1 of Table V-11. It can be seen from the table that the benefits amounted to $42,557 in the case of the Technical program, as compared to $20,520 in the case of the Home Economics program.

The same index has been used to estimate six-year benefits, attributable to vocational education. As shown in Table V-11, Column 2, such benefits range from $11,363 in the case of Technical to $4,781 for Home Economics, with benefits for other programs falling within the range of these two programs.

Ratios of total social unit benefits to unit costs are shown in Column 4 of Table V-11. Column 4 shows a range of ratios of 190.1:1 to 5.5:1. In the case of the Distribution program it is again quite clear that this program is the most effective one, due mainly to low unit costs. The same

was the case with the program on Human Resources and Industrial Arts. On the other hand, due to high unit costs in the programs of Cooperative Industry Occupation and Agriculture, the benefit:cost ratio was low.

Column 5 of Table V-11 provides discounted benefit:cost ratios of benefits attributable to vocational education. Ratios were low in Agriculture, Cooperative Industry Occupation and Health programs. On the other hand, ratios were quite favorable in the case of Distribution and Human Resources and Industrial Arts programs.

TABLE V-11

	Present Value of 0/ five Future Year Social Benefits			Ratio	
	Gross (1)	Attributed to Vocational Education (2)	Unit Cost (3)	(1):(3) (4)	(2):(3) (5)
Agriculture	29,464	5,598	4,240	6.9:1	1.3:1
Distribution	33,269	9,348	175	190.1:1	53.4:1
Health	34,520	9,493	3,551	9.7:1	2.7:1
Home Economics	20,520	4,781	1,376	14.9:1	3.5:1
Office Occupation	21,685	6,504	728	29.8:1	8.9:1
Trade and Industry	27,322	7,814	850	32.1:1	9.2:1
Cooperative Industry Occupation	32,147	8,584	5,835	5.5:1	1.5:1
Technical	42,557	11,363	5,298	8.0:1	2.1:1
Human Resources Industrial Arts	34,185	8,785	696	49.1:1	12.6:1

GOVERNMENT REVENUES AND VOCATIONAL EDUCATION

Vocational education programs help a person to find a job which otherwise might not be available to him. When there is a scarcity of trained personnel, vocational education programs help to fill the need. In both cases, vocational education programs increase the benefits to the economy of the society of Puerto Rico.

Elsewhere, we have estimated that vocational education programs directly created benefits of $58.4 million. As explained before, these benefits, with the multiplier effect, increased to $116.9 million. It is the income which is subject to the Commonwealth's system of taxes. The system of taxes of the Government of Puerto Rico includes taxes such as: personal income tax, corporate tax, property tax, excise tax, licenses, etc. In addition, the Federal Government imposes a number of taxes on imports in Puerto Rico which are reimbursed to the Government of Puerto Rico.

It has been estimated by the Department of the Treasury of the Commonwealth of Puerto Rico that different income brackets pay different rates of taxes, the details of which are given in Table V-12.

If we assume that the $116.9 million of benefits bear the burden of an average 14 per cent tax rate, then Government revenues amount to $16.4 million. Elsewhere, we have estimated that the Department of Education spent $23.5 million on vocational education in 1969-70. This means that the Government of Puerto Rico received 69.8 per cent of the vocational school expenditures in the form of tax and nontax revenues. Thus, within a period of 17 months of graduation the Government of Puerto Rico received back from the salaries of the vocational schools' 1969-70 graduates the entire amount expended for their training program.

TABLE V-12

DISTRIBUTION OF THE TOTAL TAX BURDEN IN PUERTO RICO

BY SOURCE AND INCOME GROUP, FISCAL 1968

Source	Family Personal Income Group						
	Under $2,000	$2,000-2,999	$3,000-3,999	$4,000-4,999	$5,000-7,499	$7,500 And Over	All Groups
Total taxes, excluding social insurance	13.0%	10.8%	13.6%	10.9%	12.8%	21.3%	15.1%
Commonwealth taxes:							
Individual income	0.1	0.3	0.9	1.1	2.0	8.4	3.3
Corporation and partnership income	1.8	1.3	1.4	1.2	1.2	4.1	2.2
Excises	7.1	6.0	7.6	5.3	6.2	5.3	6.0
Customs	1.3	1.0	1.2	1.0	1.0	0.8	1.0
Licenses	0.3	0.3	0.6	0.5	0.7	0.7	0.6
Property	0.9	0.7	0.7	0.7	0.7	0.6	0.7
Inheritance and gift	-	-	-	-	-	0.4	0.1
Total	11.4%	9.7%	12.4%	9.8%	11.7%	20.4%	14.0%
Municipal taxes:	1.5%	1.1%	1.2%	1.1%	1.1%	1.0%	1.1%

Source: Commonwealth Department of Treasury, 1969.

TABLE V-13

A COMPARISON OF VOCATIONAL PROGRAM EXPENDITURE

WITH GOVERNMENT REVENUES

	($000) Vocational Program Expenditures 1969-70 (1)	Government Revenues in 12 months (2)	(2) as % of (1)
Agriculture	$ 2,057	$ 309	15.0%
Distribution	1,520	6,276	412.8
Health	2,568	542	21.1
Home Economics	3,178	1,009	31.7
Office Occupation	2,930	1,894	64.6
Trade and Industry	6,123	4,275	69.8
Cooperation Industry Occupation	1,715	205	11.9
Technical	1,966	343	17.4
Human Resources Industrial Arts	1,419	1,512	106.5
Total	$23,476	$16,365	69.7%

By programs, however, the results appear to be different. Among the nine programs analyzed in the study, there were two programs - Office Occupations and Trade and Industry - whose percentages of revenues to costs approximated the overall average. The other seven programs were not very close to the overall percentage. The program of Distribution brought a return of more than four times the costs incurred by the Government. Similarly, the program of Human Resources and Industrial Arts brought a rate of return of over 100 per cent to the Government of Puerto Rico in the form of tax and nontax revenues. But the programs of Agriculture, Cooperative Industries occupations, Health and Technical brought revenues which were in the range of 11.9 per cent for Cooperative Industry and 31.7 per cent for Home Economics. The details of Government revenues by programs are shown in Table V-13.

INDIVIDUAL BENEFITS AND TAX REVENUES

As shown in Table V-14, the benefits accruing to individuals under different programs vary sharply. On the one hand, the Technical program brought to an average student a return of approximately $3,300, while the program of Home Economics brought to an individual a return of only $1,560. These incomes, as stated previously, are subject to different effective tax rates. It has been estimated by the Commonwealth Department of the Treasury that incomes below $2,000 pay an effective tax rate of 11.4 per cent; incomes in the range of $2,000 to $2,999 pay an effective tax rate of 9.7 per cent, and incomes of $3,000 to $3,999 pay an effective tax rate of 12.4 per cent. In the second column of Table V-14, the effective rates are shown for each program. When the effective tax rates are applied to individual incomes corresponding to different programs, we obtain taxes paid by individuals. These taxes are shown in Column 5 of Table V-14. The taxes paid by a student from a Technical program amounted to $409, as compared to $178 in the case of a student from a Home Economics program. Column 5 of Table V-14 should be seen with a view to determining the taxes paid by graduates under different programs.

BENEFITS ATTRIBUTABLE TO VOCATIONAL EDUCATION AND GOVERNMENT REVENUES

Elsewhere, we have shown that no benefits accruing to an individual due to vocational education are less than the total benefits accruing to an individual without vocational education. By this we mean that only those benefits are attributed to vocational education which a graduate would not be able to receive without it. Such benefits would generally accrue to an individual over his lifetime, since generally, a vocational school graduate leaves the school system at the age of 20 and continues to work up to the age of 65. This means that most likely the benefits would accrue to him over the

TABLE V-14

GOVERNMENT REVENUES ATTRIBUTABLE TO INCOME FROM

VOCATIONAL EDUCATION BY PROGRAMS

	Individual Benefit (Unit) (1)	Effective Tax Rate (2)	Benefits Attributed to Vocational Education Year Period (Unit) (3)	Total Social Benefits in One Year [1] (4) (000 of $)	Tax Revenues (1)x(2) (5)	Tax Revenues (3)x(2) (6)	Tax Revenues (4)x14% (000 of $) (7) (000 of $)
Agriculture	$2,284	9.7%	$5,598	$ 2,210	$222	$543	309
Distribution	2,579	9.7	9,348	44,832	250	907	6,276
Health	2,676	9.7	9,493	3,870	260	921	542
Home Economics	1,560	11.4	4,781	7,210	178	545	1.009
Office Occupations	1,681	11.4	6,504	13,528	192	741	1,894
Trade and Industry	2,118	9.7	7,814	30,534	205	758	4,275
Cooperative Industry Occupation	2,492	9.7	8,584	1,466	242	833	205
Technical	3,299	12.4	11,363	2,448	409	1,409	343
Human Resources Industrial Arts	2,650	9.7	8,785	10,800	257	852	1,512
				$116,898			16,365

[1] Effective tax rate is assumed to be 14%.

period of his working life of 45 years. While we have not estimated in the study the benefits accruing to an individual over his lifetime, we have estimated the present value of benefits accruing to an individual over a period of five future years. These benefits are shown in Column 3 of Table V-14. The benefits differ from $11,363 to $4,781. For other programs, net benefits may be seen in Column 3 of Table V-14 also. Effective tax rates applicable to these incomes are shown in Column 2 of Table V-14. To obtain the Government revenues over a period of six years, we apply the data given in Column 3 by the effective rate given in Column 2. Column 6 of the Table shows that the Government would receive from such incomes to individuals, revenues in the range of $543 for a student in the Agriculture program and $1,409 for a student in the Technical program. Further details of revenues are shown in Table V-14.

OTHER BENEFITS FROM VOCATIONAL EDUCATION PROGRAMS

In the previous sections we have discussed benefits emerging from vocational education in the form of increased wages and salaries. Not only do salaries and wages increase but more jobs are also available. Likewise, availability of skilled labor is a very significant incentive for manufacturing plants to locate in Puerto Rico.

Vocational education increases the gross product of Puerto Rico. Increased salaries and wages through the multiplier effect increases the demand for goods and services, the supply of which requires more investment, employment of workers and social infrastructure.

A trained labor force increases productivity, reduces capital expenditures, and increases returns on investment. Higher profitability is one of the most effective stimulants for investment.

Increases in salaries, wages and gross product raises tax and non-tax revenues substantially. Also, vocational education improves skills and job opportunities and it keeps the young people from idling in the streets. A significant number of crimes, particularly of Type II are committed in Puerto Rico by young people who are neither employed nor attending schools. Each crime committed requires deputation of police resources, patrolling, investigation, apprehension, appearance in court and escort to jail; each requires the time of courts and jail staff; and each crime may cost the Government thousands of dollars additionally through loss of working time to a private citizen (i.e., the victim of the crime). To the extent vocational education provides employment to young people otherwise unemployed, it reduces Government expenditures and improves the quality of services that can be made available to the public.

Higher wages and salaries tend to reduce dependency on the Government for services such as health, housing, and welfare. Quantification of affected services is difficult at this stage of knowledge; nevertheless, it is quite obvious that people with incomes would be less inclined to seek Government assistance than people without incomes.

Higher wages and salaries could help improve family stability, improve physical health and nutrition, reduce sickness, hospitalization and thus absences from jobs. These familiar, economic and social improvements should markedly affect mental attitude, morale and aspirations and ultimately lead to more harmonious community relations. Advantages of these social developments to the children of vocational school graduates, should be significant, indeed.

LIMITATIONS OF COST BENEFIT ANALYSIS

One of the major limitations in cost benefit analysis is that the available cost data are highly inadequate. This inadequacy has been found not only in Puerto Rico but elsewhere as well. Studies conducted by Jacob Kaufman and Richard Dueker have concluded that the variable cost data does not readily lend itself to coherent analysis and that cost data pertaining to vocational education is not adequate for rigorous analytic and evaluative purposes. In addition to the inadequacy of cost data, there are difficulties in estimating the effects of training for a particular program. The effects of training and output variables cannot be estimated quantitatively with a great deal of accuracy unless a control design is used in the analysis. The best design is to compare the output variables of training with those of comparable non-training. However, to create this type of control group is a difficult proposition since different trainees have different social and demographic characteristics, different values, motivations, and other characteristics affecting their salable market experience after completion of a vocational education program.

Also, it should be noted that there are a number of benefits which cannot be measured in returns, and thus will have to be analyzed qualitatively which, of course, will be influenced very heavily by the varied judgment of the analyst. Even the comparison of benefits among different individuals assumes that different individuals draw equal benefits from a dollar of earnings. In the theory of economics this proposition is not generally accepted. It is said that a person without any income will cherish an earning of $1 much more than a person with an income of $5,000 per year.

Furthermore, it is pointed out that the vocational school programs not only benefit the community which prepares the graduates but also the community which eventually receives them as workers. Thus, if a number of

graduates from the vocational school program leave Puerto Rico in order to work in other cities of the United States, their social benefit effect is lost in Puerto Rico, particularly when there are shortages among skilled workers. However, it cannot be denied that when there is unemployment in a particular skill such an out-migration can benefit the society of Puerto Rico in the form of reduced welfare payments and increased incomes to society, since the migrants tend to send part of their incomes back home to their families in what is described as transfer payments.

VI - COST BENEFIT ANALYSIS OF SELECTED OCCUPATIONS

The Department of Education offers hundreds of courses in sub-programs of the vocational education program. A course or a nucleus of courses is required for a trainee to enter a particular trade or occupation. This section of the report relates to specific courses to specific occupations, matches costs of specific courses to benefits of specific occupations, and analyzes ratios of unit costs to unit benefits.

Since there are hundreds of courses given to prepare trainees for hundreds of occupations, it would be impossible to prepare meaningful analysis of costs of all the courses or benefits of all occupations. Thus, in this study, 19 selected occupations have been analyzed.

In the selection of occupations, 35 occupations were idenfitied at random from total occupations offered by the Vocational Education Program. The randomly selected occupations were reduced to 19 occupations with the help of the following factors:

1. Occupations related to a large number of courses;

2. Significant demand for occupations in developing Puerto Rican economy; and

3. Different occupations have varying number of graduates.

The following occupations are analyzed in detail:

Occupation Title

Draftsman

Medical Assistant

Electronic Technician

Floral Designer

Programmer Engineer Scientist

Secretary

Stenographer

Clerk Typist

Bookkeeper II

Baker

Cosmetologist

Farmer General

Auto Mechanics

Cabinet Maker

T.V. Service Repairman

Dressmaker

Electrician

Carpenter

Plumber

Matching of courses with benefits is shown in Table VI-1 columns (1) and (2). The table provides data on enrollment, dropouts and graduates by courses and occupations. For the selected courses-occupations, it may be seen that the enrollment varied from 13 to 4,096 and number of graduates varied from 1 to 1,923. Benefits from occupations were in the range of $2,001 - $3,006,000 and costs courses were in the range of $51,000 - $3,285,000. Variations in course size or occupation should provide some explanation on cost economies of scale.

Table VI-1 and Table VI-2 provide data on unit benefits, unit costs and ratio of benefit to cost. Average unit (graduate) benefit varied from $639 for a farm worker to $5,317 for an engineering and scientific programmer. It may be noted that unit benefit is derived by dividing total benefits by the number of graduates by occupations. Total benefits are derived by summation of benefits accruing to full-time employed and part-time employed.

Of course, a number of graduates were unemployed. Thus, unit benefit is not equal to earnings of either full-time employed or part-time employed. It is equal to:

Unit benefit = Total benefits ÷ number of graduates

Total benefits = Full-time employed benefits ∔ part-time employed benefits

Full-time employed benefit = Hourly wage rate x 2,080 x number of graduates full-time employed

Part-time employed benefit = Hourly wage rate x 1,040 x number of graduates part-time employed

Number of graduates = Full-time employed ∔ part-time employed ∔ unemployed

Table VI-2 also provides data on unit cost. Unit cost among the selected 19 occupations varies from $462 to $52,225. Unit cost in clerk typist occupations with 1,923 graduates was $479, and the unit cost for floral designer with one graduate was $52,225. Very exhorbitant cost for a floral designer emerges because the methodology used in the report is biased toward number of graduates, rather than total enrollment. However, if enrollment is used as denominator to determine unit cost, even then the cost for a floral designer is high at $4,017.

The unit costs of training were above average for the occupations of auto-mechanic, farm general, electronic technician, carpenter, cosmetologist, baker, and medical assistant. On the other hand, unit costs were significantly low for the occupations of secretary, stenographer, clerk typist, bookkeeper II, dressmaker and electrician.

The unit costs of providing training for a number of occupations is high due to: (1) small number of graduates (e.g., electronic technician, floral designer, engineering programmer and T.V. service repairman); (2) too many schools offering the same course with a small number of graduates from

TABLE VI-1

UNIT BENEFITS, UNIT COST, AND BENEFIT TO COST RATIO BY SELECTED OCCUPATIONS

Occupation	Graduates	Total Benefits (Dollars)	Total Costs (Dollars)	Unit Benefits (Dollars)	Unit Costs (Dollars)	Benefit:Cost
Draftsman	276	523,049	281,000	1,895	1,018	1.8:1
Medical Assistant	56	145,435	129,881	2,597	2,319	1.1:1
Electronic Technician	58	196,337	327,433	3,385	5,645	.6:1
Floral Designer	1	2,276	52,225	2,276	52,225	.04:1
Programmer Engineer Scientist	27	143,579	61,398	5,317	2,274	2.3:1
Secretary	751	1,703,822	535,000	2,268	712	3.2:1
Stenographer	559	939,581	335,000	1,680	599	2.8:1
Clerk Typist	1,923	3,006,204	921,000	1,563	479	3.3:1
Bookkeeper II	642	1,059,485	368,386	1,650	574	2.8:1
Baker	289	437,826	848,000	1,515	2,934	.5:1
Cosmetologist	238	469,208	858,000	1,971	3,605	.5:1
Farmer General	232	148,268	1,619,000	639	6,978	.09:1
Auto Mechanic	468	941,291	3,285,005	2,011	7,019	.28:1
Cabinet Maker	392	986,204	845,616	2,516	2,157	1.2:1
T.V. Service Repairman	168	344,614	449,779	2,051	2,677	.76:1
Dressmaker	198	237,768	193,058	1,201	975	1.2:1
Electrician	468	941,603	216,000	2,012	462	4.3:1
Carpenter	476	1,380,480	1,992,000	2,900	4,185	.69·1
Plumber	313	553,328	493,673	1,768	1,577	1.1:1

TABLE VI-2

BENEFIT TO COST RATIO BY SELECTED OCCUPATIONS

(From Highest to Lowest)

Occupation	Benefit to Cost Ratio
Electrician	4.3-1
Clerk typist	3.3-1
Secretary	3.2-1
Bookkeeper II	2.8-1
Stenographer	2.8-1
Programmer Engineering Scientist	2.3-1
Draftsman	1.8-1
Dressmaker	1.2-1
Cabinet Maker	1.2-1
Plumber	1.1-1
Midical Assistant	1.1-1
T.V. Service Repairman	.76-1
Carpenter	.69-1
Electronic Technician	.6-1
Cosmetologist	.5-1
Baker	.5-1
Auto Mechanic	.28-1
Farmer General	.09-1
Floral Designer	.04-1
Service Clerk	-

TABLE VI-3

Course Name (1)	Occupation Title (2)	Enrollment (3)	Drop-Outs (4)	Graduates (5)	Benefits ($000) Full-Time (6)	Part-Time (7)	Total Benefits (8)	Costs ($000) Direct (9)	Indirect (10)	Overhead (11)	Total Costs (12)
Drafting	Draftman	793	18	276	484	3	528	97	165	19	281
Medical Assistant	Medical Assistant	107	5	56	139	6	145	55	68	7	130
Electronic Technology	Electronic Technician	262	16	58	194	2	196	12	308	7	327
Floristry	Floral Designer	13	1	1	2	-	2	20	27	4	51
Scientific Data Processing	Engineering and Scientific Programmer	135	17	27	140	4	144	5	55	1	61
Secretaries	Secretary	2,080	66	751	1,504	199	1,703	111	417	7	535
Stenographer	Stenographer	1,458	180	559	821	118	939	114	193	38	345
Clerk Typist	Clerk Typist	4,096	310	1,023	2,655	351	3,006	239	643	34	901
Bookkeeper	Bookkeeper II	1,948	152	642	929	130	1,059	92	265	11	368
Bakers	Baker	400	42	289	411	27	438	70	773	5	848
Cosmetology	Cosmetologist	398	20	235	443	26	469	85	760	13	858
Agricultural Production	Farmer General	2,015	6	232	137	11	148	356	1,204	59	1,619
Mechanics	Auto Mechanic	1,165	79	468	869	72	941	162	3,098	25	3,285
Cabinet Making	Cabinet Maker	1,239	77	392	886	101	987	108	531	6	645
Radio - T.V.	T.V. Service Repairman	425	33	168	318	27	345	60	379	11	450
Dressmaking	Dressmaker	513	9	198	209	29	238	44	145	4	193
Electricity	Electrician	1,024	60	468	863	79	942	133	60	23	216

TABLE VI-3 (Continued)

Course Name (1)	Occupation Title (2)	Enrollment (3)	Drop-Outs (4)	Graduates (5)	Benefits ($000) Full-Time (7)	Part-Time (7)	Total Benefits (8)	Costs ($000) Direct (9)	Indirect (10)	Overhead (11)	Total Costs (12)
Carpentry	Carpenter	1,026	154	476	1,284	97	1,380		1,804	24	1,900
Plumber - Pipe	Plumber	772	47	313	503	51	553	67	417	9	493

*Graduates are not shown because of the nature of the course.
No benefits, since benefits are based on graduates.

Note: Occupations were chosen at random by the consultant choosing the ones with the greatest number of courses offered and which were more common. See methodology for choosing the sample in the test.

each school (e.g., medical assistants, cosmetologists, farm general, auto-mechanics, cabinet maker, T.V. service repairman); (3) the original investment is high (e.g., medical assistant, electronic technician, floral designer, engineering and scientific programmer, cabinet maker, T.V. service repairman); and (4) administrative costs are high (e.g., electronic technicians, engineering and scientific programmer, baker, dressmaker, etc.).

The unit benefit cost ratio equals the present value of benefits divided by the costs. The general rule in benefit:cost ratio evaluation is that when the benefit:cost ratio exceeds unity, the corresponding occupation is economically superior to an alternative occupation with a lower benefit: cost ratio. From purely economic efficiency criteria, in times of scarcity of funds the occupations or programs chosen for a necessary action are those having the lowest benefit:cost ratios. In times of program expansions, the occupations chosen for necessary action should be those having the highest benefit:cost ratios. There is no doubt, however, that the decision maker would almost certainly consider additional criteria of a noneconomic nature in the decision making process. The 19 occupations, listed from the highest to the lowest benefit: cost ratio, are given in Table 3.

The benefit:cost ratios calculated in this section are for individual participants in the vocational education program. The benefits to the society in general and the Government have not been calculated for the purposes in this section since the benefits to society and Government are of macro nature and must cover the total universe of occupations rather than selected occupations.

Each of the 19 occupations is analyzed in the following pages. It may be noted that for general demand analysis, we consulted the Social Services Research Center study on Puerto Rico's Present and Prospective

Technical, Skilled and Clerical Manpower and Training Needs, Vol. 1, and for scope of training for each occupation we consulted the Dictionary of Occupational Titles, 1965, Vol. I, of the U.S. Department of Labor.

BRIEF ANALYSIS OF SELECTED OCCUPATIONS

Draftsman

For the occupation of draftsman, the ratio of benefit to cost is more than unity. Annual unit benefit is estimated at $1,895, unit cost $1,018 and ratio of benefit:cost 1.8:1.

The work of a draftsman is to prepare from sketches, notes, specifications, or instructions, complete or partial drawings using established draftsman standards. A draftsman can specialize in various fields, namely: architectural, engineering, construction, structural, electrical or mechanical.

In 1968 the supply of draftsmen did not meet the demand. We note that a scarcity of trained personnel is more noticeable when the talent we refer to is of a specialized nature.

The figures prepared by the Social Science Research Center show the demand for draftsmen in 1968, 1970 and 1975:

Total employment as of September, 1968	3,564	
Anticipated employment in 1975	4,748	
Anticipated change	1,184	33.2% change
Average Anticipated Additional Employment for 1970	169	

Of the total cost, direct cost constitutes 34 per cent, indirect cost 59 per cent and overhead 7 per cent.

Direct cost	$ 94,000
Indirect cost	165,000
Overhead	19,000
	$ 278,000

The cost of $1,018 for training a draftsman is considerably lower than for most selected occupations, for the following reasons:

- low investment in equipment per student
- learning is not dependent on the instructor but on the skill of the student, therefore, larger groups can be taught with less supervision
- depreciation of equipment is minimal and its expected life duration is longer
- administration expense is lower than for a number of other occupations
- a large percentage of the graduates are employed full-time in the labor force

Medical Assistant

For the occupation of medical assistant, annual benefit was more than unity - 1.1:1, with $2,597 as unit benefit and $2,319 as unit cost.

A medical assistant aids a doctor in nontechnical or routine work. His duties include:

- preparing the patient for doctor's examination;
- taking temperature, weight, height, pulse, respiration and blood pressure and other minor test as directed by the doctor;
- collecting and observing specimens for laboratory tests;
- performing emergency treatments if necessary;
- assisting the doctor with examinations, treatments, etc.;
- maintaining charts and files of patients;
- acting as receptionist and secretary of the doctor's office or unit in the hospital.

The necessity for this type of personnel stems basically from two sources:

- doctors completing their studies and opening private offices;

. new hospitals opening or augmenting their services or capacity.

It may be noted that the number of graduates average about 2.7 per course offered. That is, in order to graduate 56 medical assistants in 1970, the Vocational Education Program offered 21 courses throughout the Island for a total cost of $129,881 or an average unit cost of about $2,319 per graduate.

This average unit cost is mainly composed of salaries, which account for about 38 per cent of total cost; buildings and improvements, which account for 11 per cent; and equipment, furniture and fixtures which account for 22 per cent.

The high cost and short life expectancy of such equipment are the key factors which make training costs high in this occupation. However, the benefit cost ratio is not correspondingly affected since the earnings per hour are high and the rate of employment is considerably higher than in most occupations analyzed.

Electronic Technician

The ratio of benefits to cost for the occupation of electronic technician is below unity. The unit benefit is estimated at $3,385, the unit cost is estimated at $5,645, and the benefit:cost ratio is 0.6:1. Although the ratio of benefit to cost of this occupation is lower than unity on the basis of one-year benefits, the ratio would be greater than unity if more than one year of benefits were taken into account. Since the working life of a trainee is probably between 40-45 years, the actual benefits will be much larger than indicated in these estimates.

One of the reasons for benefit:cost ratio being less than unity is that equipment costs for this type of training are very high, as are the maintenance costs. Moreover, obsolescence of equipment is probably greater than in most of the other courses, with perhaps a few exceptions such as the

engineering and scientific programmer, a program which is similar in nature to that of electronic technician.

The employment rate among graduates of the electronic technician program is one of the highest. Of the 58 graduates completing the program in 1969-70, 91 per cent had full-time or part-time jobs within the six months of leaving school.

An electronic technician is taught the behavior and use of the electron, the results of producing and controlling electrons, and the unique properties of electrons. He is familiar with the science that deals with electronic action in vacuums and gases and with the use of vacuum tubes, transistors and photoelectric cells. The training offered is designed for a student with 10 years' schooling although with no previous academic knowledge of electronics or advanced physics.

Therefore, the course is designed to teach the fundamentals of electronics leaving any field of specialization to post-high school studies.

Floral Designer

The course of floral design provides the student with the skills necessary to prepare floral arrangements with natural or artificial flowers. The formal education required for a floral designer to join the labor force is completion of high school.

From the eight courses given for the occupation of floral designer, there was only one graduate out of 13 students enrolled. If this graduate were to go to the labor force to obtain a full-time job, he would earn approximately $2,300 per year. The same graduate costs the Vocational Education Program approximately $42,200, creating the lowest benefit:cost ratio determined in this study.

We estimated that the break-even point for unit cost to unit benefit would be 24 graduates. Therefore, to improve the situation of this course, we suggest that:

- more students be enrolled in this occupational course; and that
- fewer courses be offered in order to reduce the cost by graduate.

Engineering and Scientific Programmer

Ratio of benefit:cost for this occupation was more than unity - 2.3:1, signifying that for every dollar of cost, the annual benefit was $2.30.

The training for this occupation is expensive. Its unit cost is $2,274, the tenth highest in the sample taken. However, the employment rate of 85 per cent plus a high rate of income per hour ($3.00) are the main reasons for a low cost:benefit ratio. In this occupation initial earnings are high and salary increases are rapid, provided the graduate had access to retraining, which in most cases is provided by the employer.

The follow-up study of 1969 shows that out of 27 graduates, 22 were full-time employed and one was part-time employed; that is, 81 per cent were employed full-time, and 4 per cent employed part-time. However, this combined 85 per cent does not include those who continued their studies. We estimate the unemployment rate for this occupation as probably very low.

An engineering and scientific programmer converts scientific, engineering, other technical problems and formulations into a format processable by computer; resolves symbolic formulations, prepares logical flowcharts and block diagrams, and encodes resolvent equations for processing by application of advanced mathematics, such as differential equations and numerical analysis, and understanding of computer capacities and limitations; resolves problems of intent inaccuracy or feasibility of computer processing; learns how to operate computers, how to analyze and correct programming and

coding errors, and reviews results of computer runs to determine necessity for modifications and reruns. This person must be thoroughly trained in the area of data processing and computer utilization.

Secretary

One of the most important occupations under the Office Education programs is that of secretary. The ratio of benefit:cost for this occupation is estimated at 3.2:1. The cost of training a secretary is low at $712, of which 75 per cent is for salaries. The direct benefit to a graduate of this program is estimated on the average at $2,268.

A secretary trained in the Vocational Education Program is supposed to be capable of performing the following duties:

a. schedules appointments for employer, gives information to callers, and generally relieves officials of clerical work and minor administrative and business details;

b. reads and routes incoming mail;

c. locates and attaches appropriate file to correspondence to be answered by employer, takes dictation in shorthand or on stenotype machine and transcribes notes on typewriter or transcribes from voice recordings, composes and types routine correspondence;

d. files correspondence and other records;

e. answers telephone and gives appropriate information, routes calls to appropriate officials and places outgoing calls;

f. greets visitors, ascertains nature of business and conducts visitors to employer or appropriate person;

g. compiles and types statistical reports.

From the follow-up studies and demand analysis, it appears that the present program in terms of numbers is adequate. However, there might be a need for the diversification of secretarial skills so that specialized training can be provided for legal and medical secretaries.

Stenographer

Another significant occupation under the program of Office of Education is that of stenographer. The ratio of benefit to cost is high at 2.8:1, whereas, the cost of training is low. The direct benefit is somewhat lower than that of the secretarial occupation.

The work of a stenographer is to take dictation in shorthand of correspondence, reports, and other matters, and transcribe the dictated material. She performs a variety of clerical duties, except when working in a stenographic pool, and may transcribe material from sound recordings.

The benefit:cost ratio in this occupation is high due to:

a. very low investment in equipment necessary to train students, especially when this equipment has a long life of about fifteen years, and

b. the number of graduates is significantly high.

Clerk Typist

Because the training cost of an average clerk typist is low, the ratio of benefit to cost is high at 3.1:1, the cost being $479 and benefit $1,563.

The clerk typist occupation was taught in 104 schools throughout the Island. These 104 schools graduated 1,923 students for an approximate average of 18 students per course. We estimate that a higher number of students can be enrolled in each one of these courses, so as to graduate a larger number of students with fewer courses. Thus, the salary expenses incurred for these courses would go down, further lowering the unit cost.

Due to the large number of graduates, the ratio of unit cost to benefit represents the second highest in the sample taken. There is a very low investment in equipment, which can be used for two other occupations as well - secretary and stenographer. Clerk typist, secretary and stenographer rank 2, 3 and 4 in the benefit:cost ratio in the sample taken.

Bookkeeper II

Once again, due to low cost, the ratio of benefit to cost is high. For every dollar of cost there is an annual return of $2.80. Investment in equipment is low and the number of graduates per course offered is relatively high. Many of the students enrolled use it as a preparatory course for a university education.

The bookkeeper is trained to keep a set of financial records. The course teaches how to keep records of the financial transactions of different types of establishments; how to verify and enter details of transactions in chronological order such as sales slips, invoices, check stubs, inventory records, and requisitions; how to summarize detail and separate ledgers using adding machines and/or bookkeeping machines and transfer data to the general ledger; how to balance books and compile records to show statistics such as cash receipts and expenditures, accounts payable and receivable, profit and loss, and other items pertinent to the operation of business.

Baker

Because hourly wage rates are low in this occupation and cost of training is high, the benefit:cost ratio is low at 0.5:1. The unit benefit is estimated at $1,515 and unit cost at $2,934.

In the training of a baker the cost of equipment is high, which is supplemented by the need for materials and supplies for training purposes. Another factor for high cost is that 289 baker graduates are trained in 27 schools, or 11 graduates per school. Such a dispersal might be affecting the economies of scale.

A very significant reason for low benefit:cost ratio, as mentioned before, is that wage rates in this industry are low. The wage rates are low because the productivity is low. Productivity depends heavily on the capital

structure, skills of workers, the relationship between capacity and production, and the size of operations. The factors related to capital and organization probably do not lend themselves to high productivity.

A vocational education student is taught how to mix and bake ingredients following recipes and how to produce breads, pastries and other baked goods. He is taught how to measure flour, sugar, shortening and other ingredients for batters, fillings, and icings, using scale and graduated containers. Among his duties he has to dump ingredients into mixing machine bowls or steam kettles to mix or cook them according to specifications; roll, cup and shape to form sweet rolls, pie crust, tarts, cookies, and related products preparatory to baking; place dough in pans, molds, or on sheets and bake in oven or in grills.

Usually, a student graduated from a vocational course does not enter the labor force as a full-fledged pastry man or baker, but undergoes a short on-the-job training in order to get acquainted with the local kitchen facilities which he will be utilizing. However, since most students are very well prepared, they can undertake the responsibilities of a baker within a relatively short time.

Bakers may specialize as biscuit bakers, bread bakers, cake bakers, doughnut bakers, as well as cake decorators and pastry men. Some of these specializations are already included in the curriculum of the Vocational Education Program to train high school students.

Cosmetologist

Ratio of benefit to cost is low, due mainly to high cost of training. Benefit:cost ratio was 0.5:1, will benefit to an average graduate of $1,971 and unit cost of $3,605. One of the factors contributing to the high cost was that number of students graduating per school was low at 7.

The cosmetology course prepares a student to provide beauty services for customers. The services taught are the following: (a) suggest hairstyles according to physical features of patron and current styles, or determine a hairstyle from the instruction of patron; (b) style hair by cutting, trimming, and tapering, using clipper, scissor and razor; (c) shampoo hair and scalp with water, liquid soap, dry powder or egg, and rinse hair with vinegar, water, lemon, or prepared rinses; (d) apply water or waving solutions to hair and set hair on rollers, in pin curls or in finger wages; (e) apply bleach, dye, or tint using hands or cotton pads to color customers' hair, first applying solution to portion of customers skin to determine if customer is allergic to solution; (f) suggest cosmetics for conditions such as dry or oily skin; (g) apply lotions and creams to customer's face and neck to soften skin and lubricate tissues; (h) massage skull and give other hair and scalp conditioning treatments for hygienic or remedial purposes; (i) perform other beauty services, such as massaging face or neck, shaping and coloring eyebrows, or eye lashes, removing unwanted hair, applying solutions that straighten hair or retain curls or waves in hair, and waving or curling hair; (j) clean, shape and polish fingernails and toenails. Areas of specialization are very frequent in this occupation.

In the great majority of cases, the cosmetologists are self-employed. A very minimal percentage of the labor force employed in cosmetology is employed by the big beauty salons. It is almost customary that once the person has taken the course in cosmetology, he or she will open his own beauty salon. The original investment necessary to be self-employed in this occupation is not significantly high. That is, one of the rooms of the cosmetologist's house is utilized as the beauty parlor or beauty salon and the rest of the house is where the person lives. Out of 238 graduates of the 1970 class, we estimate that 170 will be employed in this occupation or

related occupation; 152 will be full-time employed and 18 part-time employed. These figures represent about 72 per cent of the graduates. The remaining 28 per cent will probably continue studying or leave the labor force. If a cosmetologist is employed by a salon with more than one cosmetologist, his income is low. It is estimated that the cosmetologist's rate per hour is about $1.40. However, if the cosmetologist works in her own business, income if substantially higher. For the purpose of this study we assume that a cosmetologist earns an average of $1.40 per hour. This means that benefit:cost ratio shown in this study is lower than what the actual ratio might be.

Farmer General

The ratio of benefit:cost is very low at 0.09:1 for this occupation due mainly to the fact that many graduates do not join the occupation for which they were trained. The wage rate at $0.95 per hour is the lowest among all the occupations studied. To train an average graduate costs $6,979, while annual unit benefit is only $639.

The farmer general occupational training teaches a scientific method of raising plants and animals effectively within a tract of land. Among the duties to be performed are planting, cultivating, harvesting crops, operating farm equipment, and attending to livestock.

The outlook for agriculture in Puerto Rico is not good. Special care should be taken in the designing of future farmer general courses since the demand may not be large in the near future. The demand for such workers in the U.S. mainland, however, should not be overlooked. Some reorientation toward more mechanical skills may also pay off as the programs mechanizing agriculture make progress.

Auto Mechanic

The benefit:cost ratio for this occupation was low at 0.28:1. The cost of training an auto mechanic is very high - $7,019, and unit benefit is estimated at $2,011.

In the analysis it is assumed that the hourly wage rate for an auto mechanic is $1.60, although this may be an underestimate if an auto mechanic is self-employed. If an auto mechanic has technical knowledge, his earnings per hour could be two to three times higher than those trainees considered here. There was no way in which we could confirm this data since self-employed auto mechanics do not submit this type of information to the Labor Department.

An auto mechanic repairs automobiles. He is trained in the characteristics, the parts and functions, mechanisms, and operation of an automobile. He is trained to identify, change, repair, correct, or alter any inefficient part. Auto mechanics usually specialize in a particular section of a car, for example, tune-ups, transmission, engine, carburators, electro-mechanics, etc. Some of these specializations are taught in vocational education program in the Department of Education.

This occupation is similar to that of cosmetologist in that initial investment is very low, physical facilities are minimum and the customers usually are the friends of the trained person. Thus, these characteristics make it an occupation which is oriented more towards self-employment than to being hired by an employer.

It is a growing occupation acquiring more customers every day, based on the fact that more cars are being brought into the Island each year. It is estimated by the Puerto Rico Planning Board that the number of automobiles will reach the one million mark by 1980.

Cabinet Maker

To train 392 graduates in the Island, the Department of Education's vocational program offered 49 courses in cabinet making, costing the vocational education program $485,000 or a unit cost of about $2,157 per graduate. During the first year, the estimated 327 graduates earned approximately $986,000 or a unit benefit of $2,516 per graduate. The benefit to cost ratio of this occupation was 1.2:1.

An average cabinet maker, according to the figures obtained from the Commonwealth Department of Labor, is estimated to earn approximately $1.60 per hour if employed in the furniture industry. However, if the cabinet maker works on his own, the $1.60 per hour wage would be a low estimate, as would be the benefit:cost ratio of 1.2:1.

In cabinet making course offered by the vocational education program, the student is taught how to construct and repair wooden articles, such as store fixtures, office equipment, cabinets, and high-grade furniture using woodworking machines and hand tools; how to study blueprints or drawings of articles to be made, mark outlines or dimensions of parts on paper or lumber stock according to blueprint or drawings specifications; to match material for color, grain, or texture; to set up and operate such woodworking machines as power saw, jointer, mortiser, tenoner, moder, and shaper to cut and shape part from stock. He receives special training for trimming component parts of joints to make them fit snugly, using handtools such as planes, chisel, or wood files; how to glue, fit and clamp parts and subassemblies together to form a complete unit, using clamps or clamping machine. When he finishes the course, he may be able to repair and refashion high-grade articles of furniture; coat assembled articles with materials, such as stain, varnish, or paint, by dipping, brushing, or spraying; may install hardware, such as hinges, catches, and drawe pulls; may repair furniture, equipment, and fixtures.

Cabinet makers can specialize in different areas, such as regrigerator cabinet maker, maintenance cabinet maker, mounter cabinet assembler, etc. If we consider that this occupation is of a specialized nature, that cabinet makers can work on their own, and that the constant remodeling in Puerto Rican businesses and houses creates the demand for this type of skill, it should be agreed that there is a good future for trained cabinet makers.

Radio and T.V. Service Repairman

The cost to the Government to train 168 radio and T.V. service graduates was approximately $450,000, at a unit cost of about $2,677 per graduate. However, the earnings derived during the first year of employment were about $345,000, or a unit benefit of about $2,051 per graduate, representing a ratio of 0.76 benefits to one cost. This ratio of 0.76:1 is low probably because the basis used for calculating the ratio was the salary paid by employers to T.V. and service repairmen employed in their shops - $1.40 per hour. Those self-employed repairmen, for whom systematic data is not available, probably earn more than $1.40 per hour. Thus, benefit:cost ratio for this occupation may be higher. There is no doubt that benefit:cost ratio is more than unity if two years of working life is used in the analysis, with proper discounting of future benefits.

The courses offered by the vocational education program on radio and television service and repair enable trainees to prepare and adjust radio and television receivers using handtools and electronic testing instruments. Graduates of this course are taught to: (a) tune receivers on all channels and observe audio and video characteristics to locate source of trouble; (b) adjust controls to obtain desired density, linearity, focus, and size of picture; (c) examine the chassis for defects; (d) test voltages and resistances of circuits to isolate defects following the schematic diagram and using volmeter, oscilloscope, signal generator, and other electronic testing

instruments; (e) test and change tubes, solder loose connections and repair or replace defective parts using handtools and soldering iron, and (f) repair radios and other audio equipment.

The demand for this type of trained personnel is increasing in Puerto Rico, since more families and businesses are owning and using this equipment. The increasing number of radios and T.V.'s in Puerto Rico, as well as the specialized use of short-wave radios, closed-circuit televisions and related devices, creates a demand for the radio T.V. repairman.

The Vocational Education Program graduated 168 students in 27 courses given throughout the Island, an average of about six graduates per course. Of these 68 students, we calculate that 128, or 76 per cent will be full-time or part-time employed. Of the remaining 24 per cent of the graduates, it is expected that a great majority will continue studies at the university level or pursue further specialized courses related to T.V. and service repair.

Dressmaker

While benefit:cost ratio for this occupation is more than unity - 1.20:0, the unit benefit seems to be small, due mainly to the fact that only about 59 per cent of graduates get jobs, full or part-time. Unit benefit amounted to $1,201 and unit cost amounted to $475.

In this course, the student is taught: (a) how to take measurements of the customers to determine modification of the pattern; (b) how to position and pin pattern sections and cut fabric with scissors following pattern edge; (c) how to baste together fabric parts in preparation for final sewing; (d) how to sew fabric parts by hand or operate single-needle sewing machine that joins fabric parts to form garment; (e) how to sew falling stitch in hems of garments by hand to conceal thread.

Electrician

The ratio of benefit:cost for the occupation of electrician is high at 4.3:1, due mainly to the fact that the cost of training is low. While unit benefits amounted to $2,012, the unit cost was only $462. Among the selected occupations, this unit cost was low because (a) no special equipment was necessary for training purposes, and (b) a large number of students (468) graduated in 1969-70.

The course for electrician covers the following: (a) read plan layout, install and repair wiring, electrical fixtures, apparatus, and control equipment; (b) plan new or modified installations to minimize waste of materials, provide access for future maintenance, and avoid unsightly, hazardous, and unreliable wiring, consistent with specifications and local electrical code; (c) prepare sketches showing location of all wiring and equipment or how to follow diagrams or blueprints prepared by others, insuring that concealed wiring is installed before completion of future walls, ceilings, and flooring; (d) measure, cut, bend thread, assemble, and install electrical conduit, using such tools as hacksaw, pipe threader, and conduit benders; (e) connect wiring the lighting fixtures and power equipment using handtool, install control and distribution apparatus such as switches, relays and circuit-breaker panels, fastening them in place with screws or bolts; (f) connect power cables to equipment such as electric range or motor and install grounding leads.

Carpenter

The 476 graduates of this program cost the Vocational Education Program $1,991,025, or $4,182 per graduate. The 323 graduates employed are estimated to earn annually $1,380,480 or $2,900 per graduate. This represents a ratio of 0.69 benefit to 1.0 cost. In other words, for every

dollar that the Department of Education spent in training this graduate, he will earn $.69 during the first year in the labor market. This ratio of 0.69:1 is low, and probably one of the reasons is that 40 courses were offered in carpentry, with an average of about 12 graduates per course, increasing the cost per student. The second reason for high cost is the fact that power tools and materials are expensive and the life span of these power tools is not as long as the tools used in other occupations.

The carpentry courses offered by the Department of Education provides basic techniques on how to construct, erect, install and repair structures and fixtures of wood, plywood, and wallboard, using handtools and power tools, and conforming to local building codes. Students are taught how to study blueprints, sketches, or building plans to ascertain the type of material required, such as lumber or fiberboard, and the dimensions of the structures or fixtures to be fabricated. They are also taught how to assemble, cut, and shape materials and fasten them together with nails, dowel pins, or glue.

The demand for carpenters in Puerto Rico is high and is expected to increase as the construction industry, due to reduced interest rates, picks up its old momentum. It seems that the number of graduates being trained by the Vocational Education Program may not be enough to meet the demand. Should the number be increased, the benefit:cost ratio must go up.

Plumber

On the occupation of plumber, the Department of Education spent $493,673, or $1,577 per graduate. The 313 graduates are estimated to earn $553,328 during their first year of work, at an average of $1,768 per graduate, per year. If we compare the unit cost of training one plumber with unit benefit, the ratio would be 1.1 benefit to 1 cost.

The course offered by the vocational education program trains the student: (a) to work in assembling, installing and repairing pipe fittings and fixtures of heating, water and drainage systems according to specifications and plumbing codes; (b) to study building plans and working drawings to determine work aids required and sequence of installations; (c) to assemble and install valves, pipe fittings and pipe composed of metals, such as iron, steel, brass, and lead, and nonmetals, such as glass, vitrified clay, and plastic using handtools and power tools; (d) to join pipes by the use of screws, bolts, fittings, solder, and calk joints; (e) to install and repair plumbing fixtures such as sinks, commodes, bathtubs, water heaters, hot water tanks, garbage disposal units, dishwashers, and water softeners. The student is also taught how to repair and maintain plumbing by replacing washers in leaky faucets, mending burst pipes, and opening clogged drains.

TABLE VI-5

VOCATIONAL EDUCATION EXPENDITURES BY OCCUPATION AND BY OBJECT

(Dollars)

Occupation (# of course)	Salaries	Books & Materials	Administration	Maintenance	Building & Improvements	Equipment, Furniture & Fixtures	Others	Overhead	Total
Auto Body Repair (84)									
Direct	126,690	38,479	38,941	31,336	55,940	70,514	4,374		366,014
Indirect	733,161	5,867	65,962	2,124	2,388	301,524	293,746		1,504,752
Overhead								54,407	54,407
Total	859,851	44,346	104,903	33,460	58,328	372,038	298,120	54,407	1,925,153
%	53.1	2.7	6.5	2.1	3.6	10.0	18.4	3.6	100.0
Auto Mechanics (54)									
Direct	41,055	27,754	21,175	16,394	24,262	29,812	1,661		162,312
Indirect	2,619,922	12,856	55,111	6,134	42,317	109,726	251,639		3,097,705
Overhead								24,822	24,822
Total	2,660,977	40,610	76,286	22,728	66,579	139,538	253,300	24,822	3,284,840
%	81.0	1.2	2.3	.7	2.0	4.3	7.7	.8	100.0
Cabinet Maker (49)									
Direct	9,330	16,308	17,741	15,534	24,133	24,855	405		108,296
Indirect	272,450	5,477	47,468	3,963	28,593	108,496	64,762		531,209
Overhead								6,051	6,051
Total	281,770	21,785	65,209	19,497	52,726	133,351	65,167	6,051	645,556
%	43.6	3.4	10.1	3.0	8.2	20.7	10.1	.9	100.0
T.V. Service Repairman (27)									
Direct	4,890	10,383	9,924	9,425	11,055	13,583	731		59,991
Indirect	108,116	5,152	26,471	4,956	24,028	110,863	99,266		378,852
Overhead								10,324	10,324
Total	113,006	15,535	36,395	14,381	35,083	124,446	99,997	10,324	449,767
%	25.1	3.5	8.1	3.2	7.8	27.7	22.2	2.4	100.0
Dressmaker (21)									
Direct	3,000	6,944	7,130	6,470	9,070	10,325	287		43,226
Indirect	49,255	2,380	20,512	1,404	6,959	26,617	37,911		145,038
Overhead								4,289	4,289
Total	52,255	9,324	27,642	7,874	16,029	37,442	38,198	4,289	193,053
%	27.1	4.8	14.3	4.1	8.3	19.4	19.8	2.2	100.0

TABLE VI-5 (Continued)

Occupation (# of course)		Salaries	Books & Materials	Administration	Maintenance	Building & Improvements	Equipment Furniture & Fixtures	Others	Overhead	Total
Electrician	(37)									
Direct		23,940	13,947	16,130	12,970	15,234	13,893	1,543		138,557
Indirect		35,350	416	4,333	295	416	1,070	13,389		60,269
Overhead									23,099	23,099
Total		59,290	14,363	20,463	13,265	15,650	14,963	14,932	23,099	215,025
	%	43.7	6.7	9.5	6.1	7.2	6.9	6.9	10.7	100.0
Carpenter	(40)									
Direct		22,500	16,697	15,339	13,670	15,514	20,910	1,574		115,204
Indirect		1,463,303	6,044	44,808	3,133	8,676	61,920	265,942		1,853,826
Overhead									23,522	23,522
Total		1,485,803	22,741	60,147	16,803	24,190	82,830	267,516	23,522	1,992,552
	%	74.6	1.1	3.1	.8	1.2	4.6	13.4	1.2	100.0
Plumber	(29)									
Direct		7,110	9,910	12,256	7,464	12,438	17,106	631		66,915
Indirect		246,286	2,735	40,289	1,134	3,760	18,068	104,612		416,884
Overhead									9,430	9,430
Total		253,396	12,645	52,545	8,598	16,198	35,174	105,243	9,430	493,229
	%	51.4	2.6	10.7	1.7	3.3	7.1	21.3	1.9	100.0
Draftsman	(29)									
Direct		23,690	17,714	14,010	9,508	15,136	16,405	1,258		97,721
Indirect		141,200	465	3,424	197	1,434	2,379	15,757		164,856
Overhead									18,799	18,799
Total		164,890	18,179	17,434	9,705	16,570	18,784	17,015	18,799	281,376
	%	58.6	6.5	6.2	3.4	5.9	6.7	6.0	6.7	100.0
Medical Assistant	(21)									
Direct		9,800	8,400	8,600	6,770	9,420	11,440	452		54,882
Indirect		39,125	596	2,587	677	4,942	17,122	3,132		68,181
Overhead									5,704	5,704
Total		49,015	8,996	11,187	7,447	14,362	28,562	3,574	5,704	128,847
	%	37.7	6.9	8.6	5.7	11.1	22.0	2.8	5.2	100.0

TABLE VI-5 (continued)

Occupation (# of course)	Salaries	Books & Materials	Administration	Maintenance	Building & Improvements	Equipment Furniture & Fixtures	Others	Overhead	Total
Electronic Technician (4)									
Direct	-	1,650	1,200	2,240	1,500	3,680	577		11,477
Indirect	-	13,435	71,758	21,707	6,010	97,118	93,478		303,506
Overhead								6,930	6,930
Total		15,125	73,748	23,947	7,510	100,798	93,055	6,930	327,013
%		4.6	22.6	7.3	2.3	30.8	30.3	2.1	100.0
Floral Designer (8)									
Direct	3,700	2,760	2,840	2,290	3,100	5,391	300		20,381
Indirect	14,415	127	288	160	1,566	8,699	2,096		27,351
Overhead								4,433	4,433
Total	18,115	2,887	3,128	2,450	4,676	14,090	2,396	4,433	52,225
%	34.7	5.5	6.0	4.6	9.0	27.0	4.6	8.6	100.0
Programmer Eng. Scientist (2)									
Direct	-	1,200	1,000	1,020	960	1,240	74		5,494
Indirect	-	5,628	17,216	6,312	1,954	14,493	9,194		54,797
Overhead								1,106	1,106
Total		6,828	18,216	7,332	2,914	15,733	9,278	1,106	61,397
%		11.1	29.7	11.9	4.7	25.6	15.2	1.8	100.0
Secretaries (41)									
Direct	21,070	16,740	14,950	11,400	17,940	28,450	475		111,025
Indirect	378,145	1,144	4,923	361	1,970	23,697	6,838		417,093
Overhead								7,083	7,083
Total	399,215	17,884	19,873	11,761	19,910	52,147	7,313	7,083	535,201
%	74.6	3.3	3.7	2.3	3.7	9.7	1.4	1.3	100.0
Stenographer (51)									
Direct	7,540	18,670	20,244	19,542	21,622	24,784	1,397		114,249
Indirect	131,445	1,403	7,163	585	1,968	18,536	31,115		143,215
Overhead								28,350	28,350
Total	138,985	20,073	27,407	20,127	23,590	43,320	33,512	28,350	385,814
%	41.4	6.0	8.2	6.0	7.0	12.9	10.1	8.4	100.0

TABLE VI-5 (Continued)

Occupation (# of course)		Salaries	Books & Materials	Administration	Maintenance	Building & Improvements	Equipment Furniture & Fixtures	Others	Overhead	Total
Clerk Typist	(104)									
Direct		30,501	40,120	41,643	31,744	48,099	45,020	2,539		239,672
Indirect		543,807	2,708	13,871	920	4,184	34,846	42,945		643,281
Overhead									37,434	37,434
Total		574,308	42,828	55,514	32,664	52,283	79,866	45,484	37,434	920,387
	%	62.4	4.7	6.0	3.5	5.7	8.7	4.9	4.1	100.0
Bookkeeper II	(37)									
Direct		12,690	11,610	14,810	3,544	17,821	21,006	741		82,222
Indirect		228,687	759	4,944	387	1,467	16,637	12,199		265,080
Overhead									11,074	11,074
Total		241,377	12,379	19,754	13,931	19,288	37,643	12,940	11,074	358,376
	%	65.5	3.4	5.4	3.8	5.2	10.2	3.5	3.0	100.0
Service Clerk	(80)									
Direct		26,790	23,851	27,967	20,721	27,291	24,511	3,972		155,103
Indirect		459,146	1,523	9,216	549	2,178	17,554	67,345		557,511
Overhead									59,361	59,361
Total		485,936	25,374	37,183	21,270	29,469	42,065	71,317	59,361	771,975
	%	62.9	3.4	4.8	2.8	3.8	5.4	9.2	7.7	100.0
Baker	(27)									
Direct		16,470	10,260	11,352	10,786	9,574	11,111	441		69,994
Indirect		415,731	14,662	128,067	12,720	23,491	130,424	47,613		772,708
Overhead									5,334	5,334
Total		432,201	24,922	139,419	23,506	31,475	141,535	48,054	5,334	848,036
	%	51.1	2.9	16.4	2.8	3.7	16.8	5.7	.6	100.0
Cosmetologist	(34)									
Direct		15,402	12,619	13,764	10,706	18,683	13,404	863		85,441
Indirect		416,016	7,018	30,519	6,675	86,051	123,869	90,096		760,244
Overhead									12,836	12,836
Total		431,418	19,637	44,283	17,381	104,734	137,273	90,959	12,836	858,521
	%	50.2	2.3	5.2	2.0	12.2	16.0	16.0	1.5	100.0

VII - BENEFITS AND COSTS OF VOCATIONAL EDUCATION BY SELECTED DISTRICTS

For benefit-cost analysis purposes, eight districts have been selected. They are Camuy, Mayaguez, Ponce, San Juan, Quebradillas, Cayey, Fajardo, and Humacao.

In the selection of districts, we have attempted to ensure that the selected districts be representative of the 80 school districts in Puerto Rico. For this reason, the districts selected are of large, medium and small sizes from the standpoint of population.

The selection of districts is considered appropriate and economical since preparation of analyses for all 80 districts would be highly time consuming, unwieldy and cumbersome.

Major conclusions emerging from the cost analysis are: (a) that there are major cost variations among the districts; (b) that cost variations depend heavily on the number of graduates by districts; (c) that cost variation also depends on the number of courses offered under a program or occupation; (d) that scientific-technical types of courses increase the absolute cost of the program, as compared to nontechnical types of courses; and (e) that costs are affected by the level of courses offered - whether at the senior high school level or at the junior high school level.

On the benefit side of analysis, major conclusions emerging are: (a) that technical courses generally bring about higher level of earnings, as compared to the nontechnical courses, and (b) that benefits are seriously affected by the number of graduates joining the labor force and getting full-time or part-time jobs.

As in the previous chapters, the costs included in the analysis are current and capital costs, defined in another chapter of this report.

TABLE VII - 1

COST AND BENEFITS OF VOCATIONAL EDUCATION BY DISTRICTS

	Graduates	Costs	Benefits	Unit Cost	Unit Benefit	Ratio Benefit to Cost
Camuy	235	$121,782	$492,065	$ 518	$2,093	4.04:1
Mayaguez	1,2[illegible]	[illegible]5,171	2,[illegible]84,[illegible]12	1[illegible]4	2,207	4.[illegible]5:1
Ponce	1,109	[illegible]29,[illegible]33	2,272,81[illegible]	[illegible]5	2,049	3.12:1
San Juan:						
Río Piedras A	[illegible]74	1[illegible]1,[illegible]4[illegible]	489,[illegible]79	[illegible]13	1,854	3.0:1
Río Piedras B	1,[illegible]58	5[illegible],[illegible]00	4,09[illegible],89[illegible]	35[illegible]	2,3[illegible]	[illegible].[illegible]:1
Río Piedras C	[illegible]75	255,480	429,[illegible]73	[illegible]2[illegible]	1,5[illegible]8	1.[illegible]:1
San Juan A	[illegible]86	[illegible]30,320	1,000,[illegible]7[illegible]	1,281	2,00[illegible]	1.[illegible]:1
San Juan B	[illegible]25	[illegible]21,[illegible]12	[illegible]03,041	[illegible]9[illegible]	1,[illegible]73	1.7:1
TOTAL SAN JUAN	2,281	1,[illegible]85,140	[illegible],[illegible]20,[illegible]84	[illegible]32.39	2,153.93	3.41:1
Guebradillas	[illegible]8	120,[illegible]01	218,288	1,231.[illegible]4	2,227.43	1.[illegible]:1
Cayey	2[illegible]	284,245	442,190	1,1[illegible].47	1,[illegible].52	1.[illegible]:1
Fajardo	2[illegible]	242,[illegible]00	[illegible]08,[illegible]04	1,011.42	2,107.21	2.08:1
Humacao	[illegible]34	[illegible]03,13[illegible]	1,142,[illegible]00	[illegible]48.04	2,139.71	3.[illegible]:1
TOTALS AND AVERAGES	[illegible],[illegible]25	4,[illegible]30,117	14,[illegible]82,44[illegible]	[illegible]30.[illegible]5	2,129.17	3.[illegible]:1

All these costs are incurred by the Commonwealth Department of Education. The benefits referred to here are the monetary income, resulting from employment, of the graduates of the vocational courses. Benefits accruing to industry, society and Government are not included in this section. Also not included are the benefits which accrue due to the upgrading in the skills and knowledge of the students who leave the courses and are classified as dropouts.[1/]

RATIO OF BENEFIT TO COST

Among the eight selected districts, the ratio of benefit:cost averaged 3.33:1, with ratio of 4.75:1 in Mayaguez and 1.56:1 in Cayey. The unit cost in Mayaguez is estimated to be high. On the other hand, unit benefit is estimated to be low in Cayey. The ratio of benefit to cost is low in the districts of Fajardo (2.08:1) and Quebradillas (1.85:1).

BENEFITS BY DISTRICTS

This study revealed that the overall yearly unit benefit is $2,205. Of the number of small, medium size and large districts selected for purposes of analysis (see facing page) only one, the Cayey district, shows a unit benefit below $2,000. Quebradillas, a district with only 98 graduates presents a unit benefit of $2,227, the highest among the districts selected.

1/ The issues pertaining to dropouts are discussed in another section.

Mayaguez, a large district with 1,216 graduates of vocational courses, shows unit benefits of $2,207, which is slightly higher than the average for the Island. However, the ratio of unit benefits to unit cost for Mayaguez is 4.75:1, the highest. This is a result of its low unit cost. The district with the lowest ratio of unit benefits to unit cost is Cayey, with 1.56:1, reflecting its low unit benefit figure.

Three main factors influence the benefits per graduates; they are: (1) the number of graduates who could find jobs; (2) the salaries they are paid; and (3) the ratio of part-time to full-time employment. If more graduates are employed full-time and paid higher salaries, they will generate more income and will increase the benefits per graduate.

Figures indicate that 235 graduates from vocational education courses in Camuy earned on an annual basis $492,085, or $2,094 per graduate. Similarly, 2,981 graduates in the San Juan area increased their total yearly income by $6.4 million, which amounts to $2,154 per graduate. Except for Cayey ($1,797), all other districts selected for this analysis show average earnings per graduate in excess of $2,000. Due to the dynamics of the economy this additional income in the hands of the graduates constitutes a significant boost for the overall economy of the respective districts.

Part-time employment is more common in large metropolitan areas than in the smaller districts. While the study showed increase in income from part-time employment to be 4.5 per cent for graduates of Quebradillas and 3.7 per cent for graduates of Camuy, the corresponding percentages for Ponce and San Juan were 8.0 per cent and 6.9 per cent, respectively.

TABLE VII - 2

INDIVIDUAL BENEFITS OF VOCATIONAL EDUCATION BY DISTRICTS

	Total Direct Income		
	Part-Time	Full-time	Total
Camuy	$ 18,151	$ 473,934	$ 492,085
Mayaguez	168,335	2,516,277	2,684,612
Ponce	181,825	2,090,991	2,272,816
San Juan-			
Río Piedras A	34,502	454,968	489,470
Río Piedras B	245,305	3,852,588	4,097,893
Río Piedras C	35,745	403,828	439,573
San Juan A	88,345	912,532	1,000,877
San Juan B	41,738	351,303	393,041
Total San Juan	445,635	5,975,219	6,420,854
Quebradillas	9,916	208,372	218,288
Cayey	49,102	393,088	442,190
Fajardo	55,150	552,844	608,994
Humacao	79,090	1,063,517	1,142,607

COST BY DISTRICTS

A review of the unit costs of the districts shown on Table VII-1 reveals that the unit cost for Mayaguez is $464, the lowest of the districts selected. The unit cost for Quebradillas is $1,231, or more than two and a half times the unit cost for Mayaguez. With a vocational high school (Dr. Pedro Perea) located in Mayaguez, this district operates at far larger volumes of students than Quebradillas with enrollment of only 189 students in vocational courses. When the number of students is high several sessions can be taught with only one classroom and the same equipment; this reduces the cost substantially.

Two other districts bear unit cost exceeding $1,000. They are Cayey with $1,155, and Fajardo with $1,001. There are some reasons for this. Computer reports dealing with costs of vocational education by district revealed that the salary figure for Quebradillas is extremely high and constitutes 63.6 per cent of the total cost. Cayey is a similar case to Quebradillas. For Fajardo the Administration and Equipment costs are substantially high and constitute 50.0 per cent of the total costs for the district.

Costs of vocational education were segregated for this study into several major objects of expenditure. These object classifications can respond to six elements of cost bearing the greatest significance within the Vocational Education Programs. Cost components of lesser significance or magnitude were grouped together to form the seventh element of cost. These elements are:

. Salaries

. Books and Materials

. Administration

. Maintenance

. Buildings and Improvements

. Equipment, furniture and fixtures

. Other

Salaries constitute 23.4 per cent of the total costs for all the districts selected for benefit-cost analysis. It should be noted, however, that salaries represent only 6.2 per cent of the total costs for the district of Fajardo while it represents 30.2 per cent of the total costs for Ponce and 67.4 per cent for Cayey. This extremely high per cent for Cayey accounts for the high cost per graduate of $1,155 in this district. Similarly, Quebradillas, with salaries amounting to 63.6 per cent of the total, has a cost per graduate of $1,231, highest among the districts being analyzed.

The cost of books and materials averages 6.8 per cent of the total cost for all the districts on the table. By individual districts the percentage ranges from 2.8 for Quebradillas to 9.9 for Río Piedras A.

It should be noted that those two districts bearing the highest percentage of salaries (Quebradillas and Cayey), show the lowest percentages in books and materials.

The other elements of cost, except administration, are of a more fixed nature than salaries and books and materials. They appear within reasonable limits for the districts comprising this analysis. Administration, however, appears out of proportion with salaries, for the districts of Camuy, Río Piedras B, San Juan B, Fajardo and Humacao.

VIII - COST AND BENEFIT ANALYSIS BY VOCATIONAL SCHOOLS

Among the eight vocational schools, the following five schools with different enrollment sizes and locations, were selected for cost:benefit analysis:

School and Location

- A. Lucchetti - Arecibo
- República de Costa Rica - Caguas
- Dr. Pedro Perea Fajardo - Mayaguez
- Miguel Such - Río Piedras
- Superior Vocacional - Ponce

These five schools had 8,294 trainees enrolled in 1969-70 or 14 per cent of the total enrollment of all vocational education programs. Of these, 3,620 graduated. Total cost for these five schools is estimated at $1,542,000 and total individual benefits are estimated to amount $8.5 million. Overall unit cost and benefit are estimated at $426 and $2,337, respectively.

The unit cost data reveals that the larger the number of enrollment and graduates, the lower the cost of training of every student, and vice versa. For example, the Miguel Such school had enrollment of 2,814 and graduated 1,440, with a cost per student of $282. By contrast, the República de Costa Rica had 905 enrollment, 246 graduates, and the unit cost was $831.

Although in a less significant way, the unit benefit data also reveals that the larger the size of a school, the higher the benefits. Thus, an average graduate of Miguel Such earned $2,490 on annual basis as compared to $1,946 by a graduate of República de Costa Rica. Differences in benefits depend on the extent to which the curriculum was technical. The higher the

technical elements in a curriculum, the higher the earnings and average benefits. Benefits are also higher in a larger city as compared to a relatively small city.

Since in these five schools the students were studying for beneficial employment, the ratios of benefit:cost were much higher on the average than those calculated for programs, occupations and districts. For Miguel Such, the benefit:cost ratio was high at 8.8:1 and República de Costa Rica was 2.3:1. Table VIII-1 shows the details.

Benefits computed are on an annual basis. The working life of a vocational school graduate is probably between 40-45 years and it is during these working years that he would continuously and increasingly earn salaries and wages. As pointed out elsewhere, for comparative purposes the future benefits must be translated into present benefits with the discount approach.

TABLE VIII- 1

UNIT COST AND BENEFITS BY VOCATIONAL SCHOOLS, 1[illegible]-7[illegible]

School and Location	Enrollment	Drop-outs	Graduates	Costs	Benefits	Unit Cost	Unit Benefit	Ratio of Benefit:Cost
-A. Lucchetti - Arecibo	1,144	68	423	$ 208,427	$ 960,607	$492	$2,270	4.6:1
-República de Costa Rica - Caguas	905	39	246	204,486	478,878	831	1,946	2.3:1
-Dr. Pedro Perea Fajardo - Mayaguez	1,998	84	895	381,269	2,068,714	425	2,311	5.4:1
-Miguel Such - Río Piedras	2,814	152	1,440	406,494	3,586,899	282	2,490	8.8:1
-Superior Vocational - Ponce	1,433	46	616	341,507	1,364,953	554	2,215	4.0:1
Totals and averages	8,294	389	3,620	$1,542,183	$8,460,051	$426	$2,337	

IX - BENEFIT-COST ANALYSIS OF DROPOUTS

The benefit-cost ratio of dropouts is somewhat lower than the benefit-cost ratio of graduates. In the case of dropout, it has been assumed that his earnings on leaving the school are about 80 per cent of those of a graduate, while the cost of training him are slightly lower, discounted by the cost of books and consumable materials, a cost incurred on the basis of number of students. A comparison of benefit:cost for dropouts and graduates is shown below:

	Dropouts	Graduates
Distribution	12.17:1	0.14:1
Health	0.64:1	0.75:1
Office Occupation	2.29:1	2.30:1
Trade and Industry	2.30:1	2.50:1
Cooperative Industry Occupation	0.35:1	0.42:1
Technical	0.72:1	0.62:1
Home Economics	1.04:1	1.10:1
Human Resources and Industrial Arts	3.85:1	3.80:1

In the benefit:cost ratio of dropouts, the behavior of dropouts in vocational education as compared to general education must be clearly understood. The vocational students may be dropping out in response to job opportunities available and not because of any fundamental inability to complete a high school curriculum successfully; in other words, they may not be dropping out due to scholastic failure. This means that differential dropout rates by programs, districts and schools may be due to economic pressures of the job market in a particular occupation or area. Kaufman says, "one might even view a perceived higher dropout rate for vocational-technical schools as a measure

of its success in training students in skills related to labor market needs." He adds "that the level of school attendance and employment opportunities are found to be inversely related."[1/]

Table IX-1 provides data by programs on enrollment, dropouts, total of dropouts and graduates, cost of dropouts, unit cost, benefits of dropouts, unit benefit and ratio of benefit to cost. The unit cost of dropouts was determined as follows:

- Unit cost of dropouts = total cost of dropouts ÷ number of dropouts.

- Total cost of dropouts = total cost ÷ (number of dropouts and graduates) x number of dropouts - (expenditures on books and materials for graduates).

- Expenditures on books and materials for dropouts = apply ratio of dropout to total of dropouts and graduates to cost of books and materials by programs.

The unit benefit of dropouts was obtained by assuming that vocational dropouts are leaving due to economic pressures and opportunities, and their ability to find jobs is as high as that of graduates. However, they earn wages and salaries at a rate of about 80 per cent of graduates. The unit benefit, therefore, is 80 per cent that of a graduate. Total benefits were obtained by multiplying the number of dropouts by unit benefit by programs. The results on costs and benefits by program may be seen in Table IX-1.

Elsewhere it has been shown that young people with about ten years of education earn about 70-80 per cent of vocational school graduates, depending on the program. Since vocational dropouts have acquired salable skills, it is assumed that they might earn more than general education students, although not much more. Thus, in the absence of other data, upper limits of the general wage data are considered relevant for the purposes of this study.

1/ J. J. Kaufman Dothen, A Cost-Effectiveness Study of Vocational Education, p. 199.

Table _____

TABLE IX-1

COST AND BENEFITS OF DROPOUTS

Program	Enrollment	Dropouts	Total of Dropouts and Graduates	Total Costs	Unit Cost of Dropouts	Cost of Dropouts	Unit Benefits[1]	Benefits of Dropouts	Ratio B:C
Agriculture	4,705	24	869	$ 2,056,831	2,319	$ 55,656	$1.046	$ 25,104	.45:1
Distribution	9,781	119	8,809	1,520,312	169	20,169	2,063	245,497	12.17:1
Health	1,118	30	753	2,567,656	3,343	100,275	2.140	64,200	.64:1
Office Occupations	17,845	720	4,743	2,929,695	605	435,936	1.349	971,280	2.29:1
Trade and Industry	18,110	935	8,141	6,123,100	737	688,861	1.694	1,583,890	2.30:1
Cooperative Industry Education	725	39	333	1,715,468	5,051	196,853	1.793	69,927	.35:1
Technical	1,583	153	524	1,965,556	3,673	562,264	2.639	403,767	.72:1
Home Economics	2,597	300	2,610	3,178,350	1,193	357,989	1,248	374,400	1.04:1
Human Resources, Industrial Arts	2,543	485	2,523	1,418,837	551	267,042	2,120	1,028,200	3.85:1
Totals and Averages	59,007	2,805	20,305	$23,475,805	357	$2,685,045	$1.764	$4,766,265	1.77:1

[1] Assumed to be 80% of earnings of graduates.

In the following pages, this study analyzes the distribution of dropouts by selected districts, programs, and schools. The analysis reveals: (1) that the dropout rate is higher in big cities where dynamic economic growth is underway as compared to small towns; (2) that programs with growing occupational needs have higher rates of dropouts; (3) that schools located in major metropolitan areas with concentration in high demand occupational courses have high rates of dropouts; (4) that programs with attached economic incentives have lower rates of dropouts; (5) that more demanding courses (including science, mathematics, etc.) produce higher rates of dropouts, and (6) that a student from disadvantaged background is more likely to drop out due to job opportunity than a student from a middle class home.

DROPOUTS BY DISTRICTS

The districts used for unit cost and benefit analysis in previous sections of this report are used here for analysis of the level of dropouts by districts. Again, it should be noted that the sample of districts comprises small, medium, and large size districts representative of different areas around the Island. The dropouts data for these districts, presented below, is used as the basis for this analysis. For the districts selected, dropouts constitute 4.2 per cent of the total enrollment. The paragraphs below reveal the salient points of Table IX-2.

The district of Camuy has the lowest rate of dropouts with 1.6 per cent, while Río Piedras A, with a rate of 7.0 per cent has the highest rate of dropouts. That is, the dropout rate in Río Piedras A is more than four times that of Camuy. There are significant differences between Camuy and Río Piedras in terms of industrialization, opportunities for employment, and courses taught.

Camuy[1/] is a small town located in an area of low industrialization. Courses taught at Camuy are predominantly of the agriculture program. Naturally, employment opportunities for nongraduates at Camuy are less diversified and appealing than the employment opportunities for a student enrolled in Trade and Industry courses taught at or close to big industrial commercial areas. Therefore, the students at Camuy will tend to pursue vocational-technical training to graduation. Students at rapidly growing commercial-industrial areas are more likely to drop out of the vocational-technical courses because of opportunities for immediate employment. Traveling from home to the training center is less within a small district than the traveling required within a big city or school district. This factor also favors Camuy in maintaining a low rate of dropouts.

1/ Camuy's population has declined since 1950. Under 1970 census, it was 19,922, as compared to 20,900 in 1950. During the same period, Camuy town population increased from 2,300 to 3,892.

Ponce, being a big city, shows a per cent of dropouts 3.3 per cent lower than Mayaguez 4.9 per cent, Fajardo 4.8 per cent and most of the districts within the San Juan area. There are a number of factors behind Ponce's low dropout rate. Although it is a big city, its industrial growth occurred at a slower pace than in other areas. The people themselves retain more of the cultural elements associated with small towns than the people of other big cities in the Island. An analysis of the occupations taught at Ponce reveals that these occupations represent a balanced cross section of all the occupations comprising the Vocational Education Programs. Thus, entrants to vocational programs can select from a large variety of courses the ones that best fit their interests and capabilities. If the demand for the various skills grows in reasonable proportion to the graduates, there would be no need to hire nongraduates to do the jobs and the students will stay in school. Sociological factors, such as patterns of living which call for closer control by the parents, contribute to the low incidence of dropouts at Ponce.

DROPOUTS BY PROGRAM

The table presented below contains in summary form presents dropout data by Vocational program. The programs are listed in ascending sequence by percentage of dropouts to enrollment. These percentages range from .5 per cent for Agriculture program to a high 19.0 per cent for Human Resources, Industrial Arts program.

TABLE IX-3

DROPOUTS STATISTICS BY PROGRAM

Program	Enrollment	Dropouts	% of Dropouts to Enrollment	Graduates
Agriculture	4,705	24	.5 %	845
Distribution	9,781	119	1.2	8,690
Health	1,118	30	2.7	723
Office Occupation	17,845	720	4.0	4,023
Trade and Industry	18,110	935	5.2	7,206
Cooperative Industry Education	725	39	5.4	294
Technical	1,583	153	9.7	371
Home Economics	2,597	300	11.6	2,310
Human Resources, Industrial Arts	2,543	485	19.0	2,038
Totals and averages	59,007	2,805	4.8	26,500

For analysis purposes the nine programs are grouped in three levels of dropouts as follows:

1. Three of the programs whose percentage of dropouts is below 3.0 per cent. They are Agriculture, Distribution and Health. These programs have certain peculiarities which affect their low percentage of dropouts.

The Agriculture Program, due to the emphasis being placed on the industrial growth of the Island, does not provide sufficient job opportunities. Thus, the students who enroll in agriculture-related courses have a special interest in the subject. It is reasonable to think then that these students will stay in courses until graduation since they are with the curriculum best suited to their occupational interest and objectives.

The Distribution program gives a special incentive to the students enrolled. Most of the occupations comprising the program enable the students to derive some income while they are going to school. This income may result from part-time employment or from services rendered by the students as part of

the training itself. Since the students are deriving some income while pursuing their studies, they are less inclined to leave school for financial reasons.

The Health program presents the same basic characteristics as the Distribution program. Moreover, the program is especially attractive to students because of the social prestige of the occupations comprising it. These two factors would make the program attractive enough for the enrollees not to drop out of the courses. However, there is another factor of substantial importance: most of the occupations comprising the program grant a certificate of title which is a prerequisite for those who want to practice the occupation. In addition, some of the occupations, such as Dental Assistant, bear quasi-professional status in the community. These factors emphasize the importance of graduating and thus stimulate the students to stay in school.

2. Three of the programs, namely, Office Occupation, Trade and Industry and Cooperative Industry Education, show percentages of dropouts close to the overall average of 4.8 per cent. These three programs influence the overall average heavily since their total enrollment represents 62.1 per cent of the overall enrollment of the courses comprising this study. No special characteristics of these programs emerge from the detailed data analyzed in connection with the level of dropouts. However, it should be noted that the courses in these curricula are taught throughout the Island with no indication of extreme concentration in any given area.

The three programs together produced 11,523 graduates in the 1969-70 school year. This high number of graduates seeking jobs reduces the opportunities for employment of nongraduates. As a consequence, students stay in school longer, since they do not receive offers from industry.

3. The other three programs: Technical with 9.7 per cent, Home Economics with 11.6 per cent and Human Resources, Industrial Arts with 19.0 per cent, show percentages far higher than the overall average. Human Resources not only bears the highest percentage of dropouts but also is 7.4 percentage points higher than the second highest, 11.6 per cent, of Home Economics.

Persons trained in any of these programs are in great demand in Puerto Rico. Thus, students leaving school to accept jobs in industry and commerce account for a substantial part of the dropouts of these programs. Although the job opportunities are seen as the main reason for dropouts in these programs, other factors were identified which tend to increase further this figure or counteract the effects of the employment opportunities. These factors are discussed below.

TECHNICAL

Courses within the Technical Education Program are demanding and specialized. Courses such as Instructional Technology and Electronics Technology require certain aptitudes, in addition to some knowledge about the fields in which the technology is to be used. An Instructional Technology Specialist must be able to communicate well with the Curriculum specialists. An Electronics Technician is required to have working knowledge of telecommunications and other specialized fields. These factors put additional strain on the students, forcing those who were motivated to enroll primarily by the income potential to drop out of the course. Only those who are apt and have a valid interest in the subject stay in the course and graduate. Therefore, the more stringent requirements of the technical courses are in many cases the reason for dropouts.

On the other hand, since occupations which form the Technical Program almost invariably entails substantial income and social acceptance, the number of students willing to enroll in the courses is always far greater than the sessions and facilities can absorb. This enables a better selection of the entrants and reduces to some extent the possibility of dropouts. The fact that a diploma or certificate of completion is usually a prerequisite for employment also deters students from dropping out of the courses.

HOME ECONOMICS

Home Economics course are more popular among female students who constitute a large majority of the total enrollment. This raises reasons for dropping out uncommon to the rest of the programs, namely, marriage and increased obligations at home due to sickness, pregnancy or other reasons. Another factor contributing to the high percentage of dropouts in this program is the fact that a certificate or diploma is seldom established by the employer as a prerequisite for the job. However, the great demand for people trained in all aspects of the program is the primary reason for dropouts.

HUMAN RESOURCES

This program has special characteristics which makes it different from most of the other programs in several respects.

The program bears significant social import since it is aimed at providing needed training, retraining, and basic education for persons who are either unemployed or working substantially less than full-time, persons who will be working less than full-time or will be unemployed because their skill have become or are becoming obsolete, persons working below their skill capabilities, or disadvantaged, out-of-school youth between 16 and 21 years of age in need of occupational training and further schooling.

Characteristics of the program clientele itself suggest a high percentage of dropouts because of the socio-economic circumstances which bring the entrants into the program. Students are basically introduced into the program not because of their interest and capabilities, but because of a series of adverse circumstances, all bearing negative rather than positive implications. They see the program as an alternative to a condition of unemployment or minimum employment.

Some of the entrants are in the program trying to restart their careers, after being displaced by the application of new technology to industrial production. These are primarily adults with families and economic obligations, who will be drawn out of the program to seek immediate income at the earliest opportunity.

In summary, the causes of dropout found in other programs are operative in the Human Resources Program to some extent. However, the reason which pushes the dropout rate of this program to the highest among all the programs, at 19.0 per cent, stems from the socio-economic factors affecting the lives of the entrants.

DROPOUTS BY TYPE OF SCHOOL

The enrollment, graduates and dropout data presented on the next page in Table IX-4 confirms some of the conclusions drawn previously in this section. Since they have been discussed previously in detail, they are discussed briefly here.

It could be clearly seen that the more demanding courses generate higher rates of dropouts. The highest rate (11 per cent) of dropouts is that of the Technical Institutes. The Technical Institutes expect students with special aptitudes, interests and talents. High school and vocational curricula together are more demanding than either of them alone. For combined courses the dropout rate is higher at 5.1 per cent, as compared to secondary schools or junior high schools where dropout rates are 4.0 per cent and 0.5 per cent, respectively.

Another conclusion revealed by the table on the next page is that the opportunity for employment of nongraduates is a major reason for students to drop out of vocational-technical courses. The junior high school student has little or no opportunity for employment and this category shows 0.5 per

cent as the rate of dropouts to enrollment. The students of special centers, due to age and level of education, have far better opportunities for employment and this category shows a 5.7 per cent rate of dropout. Due to the great demand for technicians, students at Technical Institutes have the highest opportunity for employment and thus this type of school bears the highest dropout rate of 11.0 per cent.

TABLE IX-4

	Enrollment	Dropouts	% of Dropouts to Enrollment	Graduates
Secondary Schools	25,013	1,006	4.0	9,126
High Schools with Vocational Departments	6,179	315	5.1	1,994
Vocational High Schools	9,995	487	4.9	4,314
Special Centers	14,701	835	5.7	10,132
Technical Institutes	1,392	153	11.0	350
Junior High Schools	1,727	9	.5	584
Totals and Averages	59,007	2,805	4.8	26,500

APPENDIX

COMPUTER PROCESSING OF DATA
ON VOCATIONAL EDUCATION

Data processing in essence is the computerizing, processing, storing and subsequent retrieval of data. There are all kinds of ways and means of processing data at different levels of sophistication. A number of methods are presently available to management and technicians for solving a specific data processing situation or problem. However, making the appropriate selection among alternative processing approaches heavily determines the degree of success of a given data processing project. The volume of data, complexity of computations and processing, sorting requirements and the resources available are factors to be taken into account in selecting the processing approach to use in each case.

This project dealt with a significant amount of data which required substantial resequencing in order to present the results in the proper grouping and format as required for analysis. Although computations and processing were not of a highly complex nature, their requirements exceeded the capabilities of conventional processing methods. These circumstances suggested the use of computers for processing the cost and benefit data of the Vocational Education Programs. The development of the system, preparation of the computer programs and actual processing of the data was accomplished through coordinated efforts of the management of the Department, the consultants, and the data processing staff of the Department of Education, who made significant contributions to the project.

The methodology followed for producing the computer outputs contained some elements of planning which will enable the Department of Education to use the system for processing future years' data. In this sense the system is envisioned to serve as a tool to aid in the continuous analysis of the cost-effectiveness of the Vocational Education Program. Future computer reports

will be produced by feeding the new data to the computer system developed for this project. The computer programs are available at the Department of Education Computer Center. The major processing steps comprising the system are described below.

(a) Overall Design

The system utilizes magnetic tapes as the main data storage media and punched cards as the input capturing medium. The system is composed of computer programs bearing different functions. These functions are: transfer of input data from the cards to magnetic tape, editing and validation of the data, performing computations, sorting the data on tapes into different sequences and printing the various reports. The operating instructions for the system are contained in the computer programs' documentation maintained at the computer center of the Department of Education.

The basic unit of information within the system if an occupation taught at a given school. This unit of information may comprise one or more sessions. Each such unit is considered as a separate case or observation and assigned a unique number. This number is used throughout the system of identify the individual case. The case number is used in the Vocational Cost Effectiveness Analysis System as the employee number would be used in a Payroll System.

(b) Input

Data input to the system is captured in several punched cards for each individual case. These cards contain information on the location and name of the school, enrollment and graduates, and the various elements of cost and data to develop benefits figures. The system provides the mechanisms whereby these pieces of data are linked together inside the computer to form

a combined record for each case or observation. The case number facilitates this process.

(c) Data Conversion and Validation

Once the input data is captured into computer readable form (punched cards) it is fed into the computer for its conversion to magnetic tape records and validated. During this conversion and validation process the computer checks the data for completeness, reasonableness and validity. That is, the computer checks for human as well as mechanical errors on the data. It detects missing data, amounts in excess or below the established limits and mispunches of the card punching equipment.

The outputs of this stage of processing are: (1) a computer tape containing all the records which have met the validation criterias and, (2) a printed list of all those records found in error. The listed records are flagged accordingly to indicate the type of error found. Examples of error messages that could be found on the list are "cost data missing" or "Number of graduates exceeds enrollment." It can be seen that these errors could occur at the stage when data is being gathered or when it is being punched.

(d) Processing

The processing which occurs inside the computer could not reasonably be explained without the help of a number of technical concepts and terms which would require further explanation themselves. Such technical detail is beyond the scope of this report. However, there are some fundamentals of the system which merit some explanation to aid in the interpretation and analysis of the printed computer outputs and some of the tables and exhibits of this report derived therefrom. Overall processing of the various types of data flowing through the system is summarized on the next page.

1. Descriptive Data

Data of a descriptive nature is carried in the system to allow proper visual identification of the records and facilitate preparation of printed reports. For the computer, this type of data has little or no meaning; it is reader-user oriented, since for the reader a description is considerably more meaningful than a code. Therefore both codes and descriptions are maintained in the system to satisfy human as well as machine requirements. The names of the schools, districts, courses and occupations are representative of the descriptive data which is maintained in the Vocational Cost Effectiveness Analysis System in the computer.

2. Sort and Identification Keys

These keys are alphabetical or numeric codes contained within the data that enables the computer to handle different pieces of data and match identical ones, sequence the data, group and summarize similar data and segregate dissimilar data. Examples of the codes used in the system are: program codes, school numbers and occupation codes.

3. Direct Cost Data

Direct cost data is the term for those elements of cost such as salaries, books and materials, equipment, etc., which can be directly associated with an occupation being taught at a given school. Direct cost figures were developed based on the personnel assigned to each course and location and the equipment, facilities, books and materials used. Since by definition direct cost is directly associated with a course and location, the direct cost figures enter the computer already allocated by course and location (case). The computer utilizes internally the direct cost data as it is contained in the punched input cards.

4. Indirect Cost Data

The term indirect cost refers to those elements of cost which cannot be directly associated with a specific occupation and location. Overall administration and supervision and those support services not aimed at assisting a specific course and location are considered as indirect costs and processed accordingly by the system.

Indirect cost figures enter the system in lump sums by programs. This is true for all indirect costs except overall services costs which are fed as a single total for all vocational programs. These costs are allocated internally by the system using a formula which takes into account the proportion of the direct costs by occupation and location to the total direct cost. In this manner, a specific occupation taught at a given school which absorbed 10 per cent of the total direct costs will similarly be allocated 10 per cent of the total overall services costs.

Naturally, the actual computer processing of the indirect cost data encompasses a number of system steps which are not discussed here in detail. However, all the steps address themselves to performing the indirect cost allocation as described above.

5. Benefits

Computation by the system of the benefits resulting from the Vocational Education Programs depends to a great extent on the number of graduates that could get jobs with higher salaries than they were earning before enrollment. The system takes into account regular as well as part-time employment. The number of graduates engaged in full-time and part-time jobs is determined by the use of percentages for these two employment categories developed from the graduates' follow-up data furnished by the Department of Education.

The number of graduates working, times the number of hours worked during a year (1,040 hours for part-time and 2,080 for full-time) multiplied by the average rate per hour for the specific job classification constitutes the total benefits after training. To determine the net increase in benefits, the yearly income of the employed graduates before the training is deducted from the total benefits after the training.

The Vocational Cost Effectiveness Analysis System in the computer deals only with monetary income derived by the graduates of the different vocational courses. Other concepts of income are to be brought into the analysis through other methods. This is done in other sections of this report.

6. Printed Outputs

Several printed reports are produced by the computer system described in this section. All of these reports deal basically with the same types of information described above. This information is sorted in various sequences to present different points of view of the results of the study. Although the computer files created by the system could be sorted in numerous ways, the reports produced for this study present the cost and benefits information in the following sequences:

- By program type
- By district
- By school code
- By course code
- By occupation
- By type of school

All the computer reports produced present the information in detail and totals at different levels of summarization when applicable. The computer outputs provided the basic information for the tables presented in this report.

BIBLIOGRAPHY

BIBLIOGRAPHY

Abt Associates, Inc. Design for an Elementary and Secondary Education Cost-Effectiveness Model. Volume I, Model Description. Cambridge, Mass.: Abt Associates, Inc., June 1967, 165 pp. (a)

Abt Associates, Inc. Design for an Elementary and Secondary Education Cost Effectiveness Model. Volume II, The User's Guide. Cambridge, Mass.: Abt Associates, Inc., June 1967, 58 pp. (b)

Advisory Council on Vocational Education. Vocational Education: The Bridge between Man and His Work. Publication 1. In Notes and Working Papers Concerning the Administration of Programs Authorized Under Vocational Education Act of 1963 Public Law 88-210, as Amended. Subcommittee on Education, Committee on Labor and Public Welfare, United States Senate (90th Congress, 2nd Session), March 1968, Pp. 1-56 (a)

Advisory Council on Vocational Education. Vocational Education: The Bridge Between Man and His Work. Publication 2. In Notes and Working Papers Concerning the Administration of Programs Authorized Under Vocational Education Act of 1963 Public Law 88-210, as Amended. Subcommittee on Education, Committee on Labor and Public Welfare, United States Senate (90th Congress, 2nd Session), March 1968, Pp. 57-402 (b)

Anderson, Ernest F. Differential Costs of Curricula in Comprehensive Junior Colleges. Urbana, Ill.: Bureau of Educational Research, University of Illinois, 1966, 89 pp.

Austin, John J. and Sommerfeld, Donald A. An Evaluation of Vocational Education for Disadvantaged Youth. Muskegon, Mich.: The Public Schools of the City of Muskegon, April 1967, 203 pp.

Becker, Gary S. Human Capital A Theoretical and Empirical Analysis, with Special Reference to Education. New York: Columbia University Press, 1964, 187 pp.

Benson, Charles S. "Economics and Education." Review of Educational Research 37:96-102; February 1967.

Besen, Stanley M.; Fechter, Alan E.; and Fisher, Anthony C. "Cost-Effectiveness Analysis for the 'War on Poverty'." In Thomas A. Goldman (Ed.), Cost-Effectiveness Analysis, New Approaches in Decision-Making. New York: Frederick A. Praeger Publishers, 1967, Pp. 140-154.

Blaug, M. Economics of Education, A Selected Annotated Bibliography. New York: Pergamon Press, 1966, 190 pp.

Boggs, Gerald E. A Comparative Analysis of the Impact of Various Types of Curricula on the Vocational Success of School Dropouts. Doctor's thesis. Stillwater, Okla.: Oklahoma State University, 1967, 100 pp.

Borus, Michael E. "A Benefit-Cost Analysis of the Economic Effectiveness of Retraining the Unemployed." Yale Economic Essays 4:371-429; Fall 1964.

Brandon, George L. and Evans, Rupert N. "Research in Vocational Education." In Melvin L. Barlow (Ed.) Vocational Education. Chicago: National Society for the Study of Education, 1965, Pp. 263-279.

Brazziel, William F. "Effects of General Education in Manpower Programs." Journal of Human Resources 1:39-44; Summer 1966.

Cain, Glen and Somers, Gerald. "Retraining the Disadvantaged Worker." In Cathleen Quirk and Carol Sheehan (Ed.), Research in Vocational and Technical Education. Madison, Wis.: Center for Studies in Vocational and Technical Education, University of Wisconsin, 1967, Pp. 27-44.
January 1969

Carol, Arthur and Parry, Samuel. "The Economic Rationale of Occupational Choice." Industrial and Labor Relations Review 21:183-196; January 1968.

Carroll, Adger B. and Ihnen, Loren A. Costs and Returns of Technical Education: A Pilot Study. Washington, D. C.: Office of Manpower Policy, Evaluation and Research, U. S. Department of Labor, July 1966, 52 pp.

Carroll, Adger B. and Ihnen, Loren A. Costs and Returns for Investments in Technical Schooling by a Group of North Carolina High School Graduates. Economics Research Report No. 5. Raleigh, N. C.: Department of Economics, North Carolina State University, December 1967, 49 pp.

Case, C. Marston and Clark, Stephen C. A Bibliographical Guide to Operations Analysis of Education. Technical Note Number 43. Washington, D. C.: National Center for Educational Statistics, U. S. Office of Education, September 1967, 20 pp.

Corazzini, A. J. Vocational Education, A Study of Benefits and Costs (A Case Study of Worcester Massachusetts). Princeton, N. J.: Industrial Relations Section, Princeton University, 1966, 126 pp.

Corazzini, A. J. "When Should Vocational Education Begin?" In Cathleen Quirk and Carol Sheehan (Ed.), Research in Vocational and Technical Education. Madison, Wis.: Center for Studies in Vocational Technical Education, University of Wisconsin, 1967, Pp. 191-201. (VT 005 548 for ED number see January 1969 Research in Education)

Corazzini, A. J. "The Decision to Invest in Vocational Education: An Analysis of Costs and Benefits." Vocational Education. Supplement to The Journal of Human Resources, Vol. 3, 1968, Pp. 88-120.

Correa, Hector. "Measuring Education's Contribution to Economic Growth." In Stanley Elam and William P. McLure (Ed.), Educational Requirements for the 1970's, An Interdisciplinary Approach. New York: Frederick A. Praeger Publishers, 1967, Pp. 181-213.

Cvancara, Joseph G. Input-Output Relationships Among Selected Intellectual Investments in Agriculture. Doctor's thesis. Minneapolis: University of Minnesota, 1964, 127 pp. Abstract: Dissertation Abstracts 26:845; 1965.

Davie, Bruce F. Using Benefit-Cost in Planning and Evaluating Vocational Education. A Paper Prepared for David S. Bushnell. Washington, D. C.: Bureau of Research, U. S. Office of Education. November 1965, 19 pp.

Davie, Bruce F. "Benefit/Cost Analysis of Vocational Education: A Survey." In Arnold Kotz (Ed.), Occupational Education: Planning and Programming. Volume Two. Menlo Park, Calif.: Stanford Research Institute, September 1967, Pp. 309-330.

Davie, Bruce F. "Cost-Benefit Analysis of Vocational Education: A Survey." In Hearings Before the General Subcommittee on Education of the Committee on Education and Labor, House of Representatives Ninetieth Congress, First Session, on H. R. 8525 and Related Bills, A Bill to Amend the Vocational Education Act of 1963. Part I. Washington, D. C.: U. S. Government Printing Office, 1968, Pp. 105-117.

Deitch, Kenneth M. and McLoone, Eugene P. The Economics of American Education: A Bibliography. Bloomington, Ind.: Phi Delta Kappa, Inc., 1966, 67 pp.

Denison, Edward F. The Sources of Economic Growth in the United States and the Alternatives Before Us. New York: Committee for Economic Development, 1962, 297 pp.

DeWitt, Nicholas. "Investment in Education and Economic Development." Phi Delta Kappan 47:197-199; December 1965.

Drouet, Pierre. "Vocational Training Costs: Results of a Pilot Study and an Essay in Methodology." International Labour Review 97:115-113; February 1968.

Ducker, Richard L. and Altman, James W. An Analysis of Cost and Performance Factors in the Operation and Administration of Vocational Programs in Secondary Schools. Pittsburgh, Pa.: American Institutes for Research, October 1967, 40 pp.

Duis, Harold and Sanders, George. "Employment of Vocational Program Graduates." American Education 4:29; February 1968.

Eninger, Max U. The Process and Product of T & I High School Level Vocational Education in the United States: The Product. Pittsburgh, Pa.: American Institutes for Research, September, 1965.

Fein, Rashi. "Brookings Institution Conference on Vocational Education: Introduction." Vocational Education. Supplement to The Journal of Human Resources, Vol. 3, 1968, Pp. 1-16.

Gibson, Charles H. "A Cost-Benefit Analysis of Vocational-Technical Education in the Area Vocational Schools of Kentucky." Proposal for a Dissertation. Lexington: College of Education, University of Kentucky, November 1967, 20 pp.

Gough, Lowell A. and Rowe, Harold R. A Study of Factors Associated with Outcomes of MDTA Agricultural Education Projects in the Somerset Area. Final Report. Lexington, Ky.: Kentucky Research Coordinating Unit for Vocational Education, January 1968, 22 pp.

Hanoch, Giora. "An Economic Analysis of Earnings and Schooling." Journal of Human Resources 2:310-329; Summer 1967.

Hansen, W. Lee (Ed.) "Symposium on Rates of Return to Investment in Education." Journal of Human Resources 2:291-371; Summer 1967.

Hansen, W. Lee and Weisbrod, Burton A. Seminar on the Economics of Education: Investment Decisions and Contributions to Income and Economic Growth. Final Report, Project No. 6-8224. Washington, D. C.: Bureau of Research, U. S. Office of Education, August 1967, 550 pp.

Hardin, Einar. "Summary Guide for Effectiveness/Cost and Benefit/Cost Analyses of Vocational and Technical Education: A Report of the Conference." In Arnold Kotz (Ed.), Occupational Education: Planning and Programming. Volume Two. Menlo Park, Calif.: Stanford Research Institute, September 1967, Pp 379-386

Hatry, Harry P. Criteria for Evaluation in Planning State and Local Programs. In U. S. Senate, 90th Congress (First Session), A Study Submitted by the Subcommittee on Intergovernmental Relations to the Committee on Government Operations, July 21, 1967. Washington, D. C.: U. S. Government Printing Office, 1967, 42 pp.

Hatry, Harry P. and Cotton, John F. Program Planning for State County City. Washington, D. C.: George Washington University, January 1967, 72 pp.

Innes, Jon T.; Jacobson, Paul B.; and Pelligrin, Roland J. The Economic Returns to Education: A Survey of Findings. Eugene, Ore.: Center for the Advanced Study of Educational Administration, University of Oregon, 1965, 45 pp.

James, H. Thomas. "Some Reflections on the Practical Applications of PPBS." Paper presented at American Educational Research Association, Chicago, February 1968.

Johnson, Louise A. Follow-up of MDTA E and D Project Conducted by Tuskegee Institute. Washington, D. C.: Bureau of Social Science Research, Inc., May 1967, 92 pp.

Karnes, Merle B. The Efficacy of a Prevocational Curriculum and Services Designed to Rehabilitate Slow Learners Who Are School Dropout, Delinquency, and Unemployment Prone. Washington, D. C.: Vocational Rehabilitation Administration, Department of Health, Education and Welfare, August 1966, 114 pp.

Kaufman, Jacob J. "The Role of Cost-Benefit Analysis in the Evaluation of Vocational and Technical Education." Paper presented at American Vocational Association, Cleveland, Ohio, December 1967.

Kaufman, Jacob J. "Statement of Prof. Jacob J. Kaufman, Director, Institute for Research on Human Resources, Pennsylvania State University." In Hearing Before the General Subcommittee on Education of the Committee on Education, House of Representatives, Ninetieth Congress, First Session, on H. R. 9969 and Related Bills, A Bill to Amend the Vocational Education Act of 1963. Part 3. Washington, D. C.: U. S. Government Printing Office, 1968, Pp. 866-895.

Kaufman, Jacob J.; Lewis, Morgan V.; and Gumpper, David C. The School Environment and Its Influence on Educational Programs for High School Dropouts. Interim Report. University Park, Pa.: Institute for Research on Human Resources, Pennsylvania State University, January 1968.

Kaufman, Jacob J.; Schaefer, Carl J.; Lewis, Morgan V.; Stevens, David W.; and House, Elaine W. The Role of the Secondary Schools in the Preparation of Youth for Employment. University Park, Pa.: Institute for Research on Human Resources, Pennsylvania State University, February 1967.

Kaufman, Jacob J.; Stromsdorfer, Ernst W.; Hu, Teh-wei; and Lee, Maw Lin. An Analysis of the Comparative Costs and Benefits of Vocational Versus Academic Education in Secondary Schools. Preliminary Report, Project No. O. E. 512. University Park, Pa.: Institute for Research on Human Resources, October 1967, 156 pp.

Kotz, Arnold (Ed.) Occupational Education: Planning and Programming. Volume One. Menlo Park, Calif.: Stanford Research Institute, September 1967. (a)

Kotz, Arnold (Ed.) Occupational Education: Planning and Programming. Volume Two. Menlo Park, Calif.: Stanford Research Institute, September 1967. (b) HC-$8.92)

Kraft, Richard H. P. (Ed.) Education and Economic Growth. Proceedings of the First Annual Conference on the Economics of Education. Tallahassee, Fla.: Educational Systems Development Center, Florida State University, 1968, 189 pp.

Lanham, Frank W. and Trytten, J. M. Review and Synthesis of Research in Business and Office Education. Columbus, Ohio: The Center for Vocational and Technical Education, The Ohio State University, 1966, 128 pp.

Larson, Milton E. Review and Synthesis of Research in Technical Education. Columbus, Ohio: The Center for Vocational and Technical Education, The Ohio State University, 1966, 69 pp.

Law, Gordon F. "Research Visibility." American Vocational Journal 43: 33-38; April 1968.

London, H. H. How Fare MDTA Ex-trainees? An Eighteen Months Follow-up Study of Five Hundred Such Persons. Columbia, Mo.: University of Missouri, December, 1967, 203 pp.

Main, Earl D. "A Nationwide Evaluation of M.D.T.A. Institutional Job Training." Journal of Human Resources 3:159-170; Spring 1968.

Mangum, Garth L. Contributions and Costs of Manpower Development and Training. Ann Arbor, Mich.: Institute of Labor and Industrial Relations, University of Michigan, December 1967, 85 pp. (a)

Mangum, Garth L. "Evaluating Vocational Education: Problems and Priorities." In Arnold Kotz (Ed.), Occupational Education: Planning and Programming. Volume One. Menlo Park, Calif.: Stanford Research Institute, September 1967, pp. 63-90. (b)

Meyer, Warren G. and Logan, William B. Review and Synthesis of Research in Distributive Education. Columbus, Ohio: The Center for Vocational and Technical Education, The Ohio State University, 1966, 212 pp. HC-$9.24)

Miller, Robert W. and Zeller, Frederick A. Social Psychological Factors Associated with Responses to Retraining. Research Series No. 2. Morgantown, W. Va.: The Institute for Labor Studies, West Virginia University, September 1967, 58 pp.

Mood, Alexander M. and Powers, Richard. Cost-Benefit Analysis of Education. Technical Note No. 27. Washington, D. C.: National Center for Education Statistics, U. S. Office of Education, March 1967.

Page, David A. "Retraining Under the Manpower Development Act." In John D. Montgomery and Arthur Smithies (Ed.) Public Policy. Vol. 13. Cambridge, Mass.: Harvard University Press, 1964.

Pearman, Elizabeth H. Bibliography of Cost-Benefit Analysis and Planning-Programming-Budgeting. McLean, Va.: Research Analysis Corporation, February 1966, 44 pp.

Pejovich, Svetozar and Sullivan, William. The Role of Technical Schools in Improving the Skills and Earning Capacity of Rural Manpower: A Case Study. Washington, D. C.: Office of Manpower Policy, Evaluation and Research, U. S. Department of Labor, September 1966, 19 pp.
MC-$1.04)

Persons, Edgar A. The Farmer and His Educational Investment: What Are the Relationships of this Investment to Farm Success? Doctor's thesis. Minneapolis: University of Minnesota, 1966. Abstract: Dissertation Abstracts 27:1622-A; 1966.

Persons, Edgar A. "Adult Education--Does It Pay?" Agricultural Education Magazine 41:42-43; August 1968.

Sharp, Laure M. and Krasnegor, Rebecca. The Use of Follow-up Studies in the Evaluation of Vocational Education. Washington, D. C.: Bureau of Social Science Research, Inc., May 1966, 35 pp.

Silverman, Leslie J. Follow-up Study of MDTA E and D Project at North Carolina A and T State College. Washington, D. C.: Bureau of Social Science Research, Inc., March 1967, 49 pp. (MP 000 201)

Solie, Richard J. "Employment Effects of Retraining the Unemployed." Industrial and Labor Relations Review 21:210-225; January 1968.

Somers, Gerald G. "Retraining: An Evaluation of Gains and Costs." In Arthur M. Ross (Ed.) Employment Policy and the Labor Market. Berkeley, Calif.: University of California Press, 1965, Pp. 271-298. (a)

Somers, Gerald G. "Training the Unemployed." In Joseph M. Becker (Ed.) In Aid of the Unemployed. Baltimore, Maryland: Johns Hopkins Press, 1965, Pp. 227-251. (b)

Somers, Gerald G. "The Response of Vocational Education to Labor Market Changes." Vocational Education. Supplement to The Journal of Human Resources, Vol. 3, 1968. Pp. 32-58. (a)

Somers, Gerald G. (Ed.) Vocational Education. Report of a Conference Sponsored by the Brookings Institution. Supplement to The Journal of Human Resources, Vol. 3, 1968. 140 pp. (b)

Somers, Gerald G. and Stromsdorfer, Ernst T. A Benefit-Cost Analysis of Manpower Retraining. Reprinted from the Proceedings of the Seventeenth Annual Meeting, Industrial Relations Research Association, 1964, 14 pp.

Sorkin, Alan L. "Occupational Earnings and Education." Monthly Labor Review 91:6-9; April 1968.

Spiegelman, Robert G. "A Benefit/Cost Framework for Education." In Arnold Katz (Ed.), Occupational Education: Planning and Programming. Volume Two. Menlo Park, Calif.: Stanford Research Institute, September 1967. Pp. 359-377.

Stromsdorfer, Ernst W. "Economic Concepts and Criteria for Investment in Vocational Education." In Arnold Katz (Ed.), Occupational Education: Planning and Programming. Volume Two. Menlo Park, Calif.: Stanford Research Institute, September 1967, Pp. 331-357.

Stromsdorfer, Ernst W. "Determinants of Economic Success in Retraining the Unemployed: The West Virginia Experience." Journal of Human Resources 3: 139-158; Spring 1968.

Taussig, Michael K. "An Economic Analysis of Vocational Education in the New York City High Schools." Vocational Education. Supplement to The Journal of Human Resources, Vol. 3, 1968. Pp. 59-87.

Tuckman, Bruce W. and Schaefer, Carl J. Review and Synthesis of Research in Trade and Industrial Education. Columbus, Ohio. The Center for Vocational and Technical Education. The Ohio State University, 1966, 76 pp.

Tweeten, Luther G. The Role of Education in Alleviating Rural Poverty. Agricultural Economic Report No. 114. Washington, D. C.: Economic Research Service, U. S. Department of Agriculture, June 1967, 56 pp.

Warmbrod, J. Robert and Phipps, Lloyd J. Review and Synthesis of Research in Agricultural Education. Columbus, Ohio: The Center for Vocational and Technical Education, The Ohio State University, 1966, 140 pp.

Weisbrod, Burton A. External Benefits of Public Education, An Economic Analysis. Princeton, N. J.: Industrial Relations Section, Princeton University, 1964, 144 pp.

Weisbrod, Burton A. "Preventing High School Dropouts." In Robert Dorfman (Ed.) Measuring Benefits of Government Investments. Washington, D. C.: The Brookings Institution, 1965, Pp. 117-171.

Weisbrod, Burton A. "Conceptual Issues in Evaluating Training Programs." Monthly Labor Review 89:1091-1097; October 1966. (a)

Weisbrod, Burton A. "Investing in Human Capital." Journal of Human Resources 1:1-21; Summer 1966. (b)

Adams, Don (Ed.) Educational Planning, Syracuse Univ. Press, 1964.

Anderson, C., Mary Jean Bowman (Eds.), Education and Economic Development, Aldine Co., Chicago, 1965.

Balogh, Thomas, "What Schools for Africa?" Fabian Publication, March 1962; and in UNESCO, U.N. Economic Commission for Africa, Conference of African States on the Development of Education in Africa, Addis Ababa, 1961

Bowman, Mary Jean, "Comparing Streams of Economists and Educators," Comparative Education Review, Oct. 1962.

Carnoy, Martin, "The Cost and Return to Schooling in Mexico," (Ph.D. Dissertation, Univ. of Chicago, 1964).

Foster, Phillip, "The Vocational School Fallacy in Development Planning," Conference on Education and Economic Development, Univ. of Chicago, April 1963.

Janson, John, Cole Brembeck (Eds.), Education and the Development of Nations, Holt, Rinehart, Winston, New York, 1966.

Mansson, W.L., "Rates of Return to Investment in Schooling," Journal of Political Economy, Vol LXXI, 70-2, April, 1963.

Higgins, Benjamin, "Planning and Social Development - I Education," Economic Development, Norton & Co., New York, 1968.

Kaufman, Jacob, and others, A Cost-Effectiveness Study of Vocational Education, Institute for Research on Human Resources, Pennsylvania State Univ., University Park, Pennsylvania, March 1969.

Machlup , Fritz, Education and Economic Growth, Nebraska Univ. Press, Lincoln, 1970.

Mincer, Jacob, "On-the-Job Training: Costs, Returns and Some Implications," Journal of Political Economy, October, 1962.

United Nations Research Institute for Social Development, Cost-Benefit Analysis of Social Projects: Report of a Meeting of Experts Held in Rennes, France, Sept. 27 - October 2, 1965, Geneva, 1966.

Williams, Lawrence, "Modern Technology in the Changing World of Work," The Role of the University in Promoting Change, Ithaca, N.Y., Cornell Univ. Press, 1962.